SPECIFICATIONS

FOR THE CONSTRUCTION OF A

DISTRIBUTION FACILITY

FOR

HOMEGOODS

JEFFERSON, GA

OWNER:

ARCHITECT:
MACGREGOR ASSOCIATES ARCHITECTS, INC.
2839 PACES FERRY ROAD, NW, SUITE 500
ATLANTA, GEORGIA 30339

MAA PROJ NO 2013-018

JULY 31, 2013

TABLE OF CONTENTS

PRODUCT REQUIREMENTS

EXECUTION AND CLOSEOUT REQUIREMENTS

LIFE CYCLE ACTIVITIES

DIVISION 02 - EXISTING CONDITIONS

DIVISION 03 - CONCRETE

DIVISION 04 - MASONRY

DIVISION 05 - METALS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

DIVISION 08 - OPENINGS

DIVISION 09 - FINISHES

DIVISION 10 - SPECIALTIES

DIVISION 11 - EQUIPMENT

DIVISION 12 - FURNISHINGS

DIVISION 21 - FIRE SUPPRESSION

DIVISION 22 - PLUMBING

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

DIVISION 26 - ELECTRICAL

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 00 2113

INSTRUCTIONS TO BIDDERS

SUMMARY

1.1 DOCUMENT INCLUDES

A. Invitation
   1. Bid Submission
   2. Intent
   3. Work Identified in the Contract Documents
   4. Contract Time

B. Bid Documents and Contract Documents
   1. Definitions
   2. Contract Documents Identification
   3. Availability
   4. Examination
   5. Inquiries/Addenda
   6. Product/Assembly/System Substitutions

C. Site Assessment
   1. Site Examination
   2. Subsurface Investigation Report

D. Qualifications
   1. Qualifications
   2. Subcontractors/Suppliers/Others

E. Bid Submission
   1. Bid Ineligibility
   2. Submission Procedure

F. Bid Enclosures/Requirements
   1. Bid Form Requirements
   2. Fees for Changes in the Work
   3. Bid Form Signature

G. Offer Acceptance/Rejection
   1. Duration of Offer
   2. Acceptance of Offer

INVITATION

2.1 BID SUBMISSION

A. Bids must be submitted through the Oracle tool are considered signed and under seal, executed, and dated will be received by the Owner. All bids must be uploaded before 2:00 p.m. Eastern Daylight Time on the 22nd day of August using their Oracle online system. It is strongly recommended that all bids be submitted 24 hours prior to deadline to prevent system of connectivity issues from preventing a timely submission.

B. Offers submitted after the above time will not be considered unless TJX notified parties of an extended bid period prior to the scheduled closing of the RFP.

C. Offers will be opened privately immediately after the time for receipt of bids.

D. Amendments to the submitted offer will be permitted as an alternate along with the requested scope bid if received prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer. All parties must bid the requested scope of the project as their primary bid value

2.2 INTENT

A. The intent of this Bid request is to obtain an offer to perform work to complete a Distribution Facility located at Jefferson, GA for a Stipulated Sum contract, in accordance with the Contract Documents.

2.3 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

A. Work of this proposed Contract comprises building construction and site development, including general construction, structural, mechanical, electrical, and fire protection Work.

2.4 CONTRACT TIME

A. Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.

B. The Contractor shall include an allowance for all reasonably foreseeable adverse weather conditions at the location of the project, affecting items of work on the critical path. Time extensions will be considered only for unusual weather greatly in excess of that normally occurring at the location of the project. The Contractor shall be required to demonstrate the effect of such delays on the Critical Path Schedule and must submit a timely claim as set forth in the Contract. Claims for additional costs shall not be granted for weather delays. For purposes hereof, "adverse weather" shall mean weather that prevents the performance of any productive work and which could not reasonably be anticipated for the period of construction of the Work. Time delays may be broken down into one-half days if a minimum of 4 hours of the day was productive.

C. The Contractor shall indicate on the Bid Form the number of days that have been included to allow for adverse weather conditions affecting items of work on the critical path.

BID DOCUMENTS AND CONTRACT DOCUMENTS

3.1 DEFINITIONS

A. Contract Documents: Defined in AIA A201 Article 1 including issued Addenda.

B. Bid, Offer, or Bidding: Act of submitting an offer under seal.

C. Bid Amount: Monetary sum identified by the Bidder in the Bid Form.

3.2 CONTRACT DOCUMENTS IDENTIFICATION

A. The Contract Documents are identified as Project Number 2013-018, as prepared by Architect who is located at 2839 Paces Ferry Rd, Suite 500; Atlanta, GA 30339, and with contents as identified in the Table of Contents.

3.3 AVAILABILITY

A. Initial Bid Documents shall be provided by the Owner to each bidder in PDF format.

B. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.

3.4 EXAMINATION

A. Upon receipt of Bid Documents verify that documents are complete. Notify Owner thru Oracle should the documents be incomplete.

B. Immediately notify Owner thru Oracle upon finding discrepancies or omissions in the Bid Documents.

3.5 INQUIRIES/ADDENDA

A. Questions and Answers; All questions regarding the content of the RFP must be posted utilizing the Oracle online discussion tool. TJX will receive a notification when a new question is posted, and will respond to the question in a timely fashion. Suppliers will receive an email each time responses are published, and will be prompted to log in and view the posted.

B. Addenda may be issued during the bidding period. All Addenda become part of the Contract Documents. Include resultant costs in the Bid Amount.

C. Verbal answers are not binding on any party.

D. Clarifications requested by bidders must be submitted via the Oracle Tool not less than 7 days before date set for receipt of bids. The reply will be in the form of a response in the on-lone discussion section or if appropriate as an Addendum which will be posted to the FTP site along with Oracle notification of its availability.

3.6 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS

A. Where the Bid Documents stipulate a particular product, substitutions will be considered up to 7 days before receipt of bids.

B. When a request to substitute a product is made, Architect may approve the substitution and will issue an Addendum to known bidders.

C. The submission shall provide sufficient information to determine acceptability of such products.

D. Provide complete information on required revisions to other work to accommodate each proposed substitution.

E. Provide products as specified unless substitutions are submitted in this manner and accepted.

F. See Section 01 6000 - Product Requirements for additional requirements.

SITE ASSESSMENT

4.1 SITE EXAMINATION

A. Examine the project site before submitting a bid.

4.2 SUBSURFACE INVESTIGATION REPORT

A. A subsurface investigation report obtained for use in the design of pavement and foundations shall be provided by the Owner.
   1. Contractor shall assume responsibility for any conclusions drawn from the data.
   2. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner and his consultants will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.
   3. Data are made available only for the convenience of Contractor. The Contractor shall perform any additional subsurface investigation necessary to completely familiarize and satisfy himself as to the existing conditions at no cost to the Owner.

QUALIFICATIONS

5.1 SUBCONTRACTORS/SUPPLIERS/OTHERS

A. Owner reserves the right to reject a proposed subcontractor for reasonable cause.

BID SUBMISSION

6.1 SUBMISSION PROCEDURE

A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.

B. Submit one copy of the executed offer on the Bid Forms provided, signed and sealed, via the Owner's Oracle online system.

6.2 BID INELIGIBILITY

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.

B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be declared unacceptable.

C. Failure to provide bonding or insurance requirements may, at the discretion of Owner, invalidate the bid.

D. Bids are by invitation, only from selected bidders. Bids from unsolicited bidders may be returned.

BID ENCLOSURES/REQUIREMENTS

7.1 BID FORM REQUIREMENTS

A. Complete all requested information in the Bid Form and Appendices.

7.2 FEES FOR CHANGES IN THE WORK

A. Include in the Bid Form, the overhead and profit fees on own Work and Work by subcontractors, applicable for Changes in the Work, whether additions to or deductions from the Work on which the Bid Amount is based.

7.3 BID FORM SIGNATURE

A. The Bid Form shall be signed by the bidder, as follows:
   1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
   2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
   3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
   4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

OFFER ACCEPTANCE/REJECTION

8.1 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the bid closing date.

8.2 ACCEPTANCE OF OFFER

A. Owner reserves the right to accept or reject any or all offers.

B. After acceptance by Owner, a written Notice To Proceed will be issued by the Owner to the successful bidder.

END OF INSTRUCTIONS TO BIDDERS

SECTION 00 4100

BID FORM

THE PROJECT AND THE PARTIES

1.1 TO:

A. _____ (Owner)

1.2 FOR:

A. _____

1.3 DATE: _____ (BIDDER TO ENTER DATE)

1.4 SUBMITTED BY: (BIDDER TO ENTER NAME AND ADDRESS)

A. Bidder's Full Name _____
   1. Address _____
   2. City, State, Zip_____

1.5 OFFER

A. Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Macgregor Associates Architects, Inc. and engineering consultants for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

B. _____
_____ dollars
($_____), in lawful money of the United States of America.

C. All applicable federal, state and local taxes are included in the Bid Sum.

1.6 ACCEPTANCE

A. This offer shall be open to acceptance and is irrevocable for sixty days from the bid closing date.

B. If this bid is accepted by Owner within the time period stated above, we will:
   1. Execute the Agreement within seven days of receipt of Notice of Award.
   2. Furnish the required bonds within seven days of receipt of Notice of Award.
   3. Commence work within seven days after written Notice to Proceed of this bid.

1.7 CONTRACT TIME

A. If this Bid is accepted, we will:

B. Complete the Work in _____ calendar days from Notice to Proceed.

C. We have included _____ calendar days to allow for adverse weather conditions affecting items of work on the critical path.

1.8 CHANGES TO THE WORK

A. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
   1. _____ percent overhead and profit on the net cost of our own Work;
   2. _____ percent on the cost of work done by any Subcontractor.

B. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus _____ of the overhead and profit percentage noted above.

1.9 ADDENDA

A. The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.
   1. Addendum # _____ Dated _____.
   2. Addendum # _____ Dated _____.

1.10 BID FORM SUPPLEMENTS

A. A Bid Breakdown spreadsheet will be provided under separate cover for Bidders to provide pricing for the Work including Unit Prices and Alternatives. Do not add lines or delete lines from this spreadsheet.

1.11 BID FORM SIGNATURE(S)

A. The Corporate Seal of

B. _____

C. (Bidder - print the full name of your firm)

D. was hereunto affixed in the presence of:

E. _____

F. (Authorized signing officer, Title)

G. (Seal)

H. _____

I. (Authorized signing officer, Title)

1.12 IF THE BID IS A JOINT VENTURE OR PARTNERSHIP, ADD ADDITIONAL FORMS OF EXECUTION FOR EACH MEMBER OF THE JOINT VENTURE IN THE APPROPRIATE FORM OR FORMS AS ABOVE.

END OF BID FORM

SECTION 01 1000

SUMMARY

PART 1 GENERAL

1.1 PROJECT

A. Project Name: HomeGoods Distribution Center, Jefferson, Georgia.

B. Contract Documents: Requirements of the work are contained in the contract documents, and include cross-references herein to published information, which is not necessarily bound therewith.

C. Verbal Summary: Without force and effect on the requirements of the Contract Documents, the description of the work of the contract can be summarized as follows:
   1. Building: Construction consists of one building: a single story structure of approximately 800,722 square feet with an approximately 35,520 square feet of structured conveyor platform.
   2. The building will be slab on grade, steel frame construction with load bearing concrete tilt-up wall panels. The facility will be fully sprinklered. Major work components include but are not limited to concrete, structural steel, steel joists, metal deck, roofing system and accessories, hollow metal doors and frames, overhead doors, aluminum entrances, windows, hardware, skylights, glazing, loading dock equipment, plumbing, fire protection, heating-ventilating-air conditioning, electrical systems, lighting, etc.
   3. A portion of the building will require a superflat concrete slab on ground.
   4. The sitework has been bid and awarded, with the intent to assign their contract to the Contractor. Sitework Contractor scope of work includes but is not limited to:
      a. Clearing/Grubbing/Grading including backfilling of curb and gutter
      b. Fine grading of all building and pavement pad areas utilizing a laser grader and handed over to selected GC/concrete sub.
      c. Erosion/Sedimentation Control, including detention ponds, rip-rap, etc.
      d. Storm Drainage System.
      e. Sanitary Sewer System including relocations and force main work, but not in the contract is the RACO Sanitary Sewer Extension (separate set of documents).
      f. All other related work to perform the above.
   5. Sitework components included in the Contractor scope of work includes but is not limited to:
      a. Curb and gutter, including throats and tops
      b. Heavy duty concrete pavement.
      c. Light duty asphalt pavement.
      d. Water Distribution
      e. Sidewalks
      f. Fencing
      g. Landscape and irrigation.
      h. Striping

D. The Work will be constructed under a single prime contract.

1.2 WORK FURNISHED BY THE TENANT UNDER SEPARATE CONTRACTS

A. The Tenant will award separate contracts for the performance of certain construction operations at the site. Those operations will be conducted simultaneously with work under this Contract. Those contracts include the following:
   1. Material Handling Equipment.
   2. Pallet Racking

3. Battery Chargers and Racking.
4. Telephone and Data Cabling.
5. CCTV Camera and Security System.
6. Office Furniture.
7. Conveyor Systems
8. Interior Floor Striping
9. Column Protectors
10. Bar Code Cabling
11. A/V Equipment

B. Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract.

C. Permanent lighting shall be operational when the racking and material handling equipment installation is scheduled, so that adequate lighting is provided in all areas where work will be carried out. Contractor shall be responsible for these utility costs until Date of Substantial Completion.

D. Contractor shall provide access to the building for Tenant's contractor to perform work from 7:00 AM to 7:00 PM, Monday through Friday.

1.3 CONTRACTOR USE OF PREMISES

A. General: During the entire construction period, the Contractor shall coordinate use of the site with all work being performed under separate contracts
   1. Use of the Site: Confine operations at the site to the areas required for performance of the contract.
   2. Do not encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to areas designated by the Owner.
   3. Smoking or open fires will not be permitted within the building enclosures.

1.4 OWNER OCCUPANCY

A. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building, prior to Substantial Completion provided that such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the Work.
   1. Obtain a Certificate of Occupancy from local building officials prior to partial Owner occupancy if required.
   2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational when applicable. Required inspections and tests shall have been successfully completed.

1.5 CONNECTION, USE FEES, ETC.

A. Including building and site development permits, water, sanitary sewer and power company fees for underground service from utility to transformer and to the building are to be paid by Owner. The contractor shall be responsible for costs of physically tapping into various utilities and trade permits.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2000

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Procedures for preparation and submittal of application for final payment.

1.2 SCHEDULE OF VALUES

A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

B. Forms filled out by hand will not be accepted.

C. Submit a printed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet. Contractor's standard form or electronic media printout will be considered.

D. Submit Schedule of Values in duplicate within 14 days after date established in Notice to Proceed.

E. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Present required information on electronic media printout.

E. Form: AIA G702 Application and Certificate for Payment and AIA G703 - Continuation Sheet including continuation sheets when required.

F. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Total Completed and Stored to Date of Application.
   7. Percentage of Completion.

8. Balance to Finish.
9. Retainage.

G. Execute certification by signature of authorized officer.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

I. Submit three copies of each Application for Payment.

J. Include the following with the application:
1. Transmittal letter as specified for Submittals in Section 01 3000.
2. Partial Release of Liens: With each Application for Payment, submit conditional waivers of mechanics lien from every entity who may lawfully be entitled to file a mechanics lien arising out of the Contract, and related to the Work covered by the payment.

K. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.4 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.

B. Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time as authorized by the Conditions of the Contract by issuing supplemental instructions on AIA Form G710.

C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
2. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor shall prepare and submit a fixed price quotation within 14 days.

E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
3. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

G. Substantiation of Costs: Provide full information required for evaluation.
1. Provide following data:
a. Quantities of products, labor, and equipment.
b. Taxes, insurance, and bonds.
c. Overhead and profit.

d. Justification for any change in Contract Time.
e. Credit for deletions from Contract, similarly documented.

2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.5 APPLICATION FOR PAYMENT AT SUBSTANTIAL COMPLETION

A. 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 proceed or coincide with this application include:
1. Occupancy permits and similar approvals.
2. Application for reduction of retainage, and consent of surety.
3. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

1.6 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in Section 01 7000.
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. Proof that taxes, fees and similar obligations have been paid.
6. Removal of surplus materials, rubbish and similar elements.

END OF SECTION

SECTION 01 2200

UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.2 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.3 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.4 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities will be verified by Owner.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

1.5 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

1.6 SCHEDULE OF UNIT PRICES.

A. Place crusher run stone, compacted to specified density in place. $ _____per ton.

B. Bulk rock excavation (blast). $ _____per c.y.

C. Trench rock excavation (machine). $ _____per c.y.

D. Light Duty Asphalt Paving. $ _____per s.y.

E. Concrete Paving. $ _____per s.y.

F. Concrete curb and gutter - typical $ _____per lf

G. Concrete curb and gutter - 12 inch high curb $ _____per lf

H. Fire extinguishers per unit installed cost. $ _____each

I. Installed duplex receptacle in office area. $ _____each

J. Installed voice/data box in office area. $ _____each

K. Installed 2x4 light fixture in office area. $ _____each

L. General Conditions. $ _____per day

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2300

ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for pricing alternates.

B. Documentation of changes to Contract Sum and Contract Time.

1.2 RELATED REQUIREMENTS

A. Document 00 2113 - Instructions to Bidders: Instructions for preparation of pricing for alternatives.

B. Document 00 4323 - Alternates Form: List of alternatives as supplement to Bid Form.

1.3 ACCEPTANCE OF ALTERNATES

A. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.

B. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted alternates will be identified in the Owner-Contractor Agreement.

C. Coordinate related work and modify surrounding work to integrate the Work of each alternate.

1.4 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - Delete Performance and Payment Bond:

B. Alternate No. 2 - Delete curb and gutter, including throats and tops.

C. Alternate No. 3 - Delete light duty asphalt paving.

D. Alternate No. 4 - Delete 4 inch GAB under the heavy duty concrete paving.

E. Alternate No. 5 - Delete site water distribution including meters, vaults, domestic water piping to 5 ft from building, fire hydrants and PIV's, and complete underground fire line that terminates within the building 1 ft above the finish floor.

F. Alternate No. 6 - Delete asphaltic joint caulking of the exterior concrete pavement.

G. Alternate No. 7 - Delete 2 inch asphalt strip behind all trailer spaces against adjacent curb, in lieu of grassing.

H. Alternate No. 8 - Delete clerestory windows at Low Bay Warehouse area.

I. Alternate No. 9 - In lieu of titl-up concrete wall panels, provide insulated precast wall panels (minimum R-10 insulation).

J. Alternate No. 10 - In lieu of heavy duty concrete paving throughout the project, provide heavy duty asphalt paving in areas indicated on the civil drawings as an alternate paving design.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 3000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preconstruction meeting.

B. Progress meetings.

C. Pre-Slab Meeting.

D. Structural Construction Observation Milestones.

E. Pre-Roof Meeting.

F. Progress photographs.

G. Webcam service.

H. Submittals for review, information, and project closeout.

I. Number of copies of submittals.

J. Submittal procedures.

1.2 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.

B. Section 01 7800 - Closeout Submittals: Project record documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRECONSTRUCTION MEETING

A. Contractor will schedule a meeting within 15 days of date established in Notice to Proceed.

B. Attendance Required:
   1. Owner.
   2. Owner's representative.
   3. Architect.
   4. Contractors Project Manager and Superintendent.
   5. Major Subcontractors.
   6. Testing Agency.
   7. Others as appropriate.

C. Agenda:
   1. Project Coordination: Designation of responsible personnel.
   2. Distribution of Contract Documents.
   3. Submission of list of Subcontractors, schedule of values, and progress schedule.
   4. Designation of personnel representing the parties to Contract, _____ and Architect.
   5. Major equipment deliveries and priorities.

6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Procedures for testing and inspection.
8. Use of premises:
   a. Jobsite trailers, work and storage areas.
   b. Owner's requirements.
9. Temporary utilities.
10. Safety and first-aid procedures.
11. Security procedures.
12. Housekeeping procedures.
13. Scheduling activities of Testing Agency.

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.2 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Owner's represenative, Architect, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to Work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.3 PRE-SLAB MEETING:

A. Schedule and administer pre-slab meeting 14 days prior to placing floor slabs.

B. Attendance Required:
1. Owner
2. Owner's Representative.
3. Architect.
4. Structural Engineer
5. Material Testing Agency's Field Representative.
6. Concrete Consultant.
7. Contractor's Project Manager and Superintendent.
8. Concrete Finishing Subcontractor.
9. Concrete Supplier.
10. Others as appropriate.

C. Suggested Agenda:
1. Subgrade preparation.

2. Formwork.
3. Sequencing of slab pours.
4. Concrete mix designs.
5. Admixtures (if any).
6. Slump - Adding water at site.
7. Reinforcement (if any).
8. Doweling of construction joints.
9. Placing and finishing procedures.
10. Sawing of control joints.
11. Curing procedure.
12. Testing procedures - concrete.
13. Testing procedures - flatness and levelness.
14. Weather conditions and precautions.
15. Protection of floor slabs:
    a. Edge breakage at temporary ramps.
    b. Anchorage of tilt panel forms and reveals.
    c. Scratching/ marring of slab during tilt panel construction and erection.
    d. Repair of tilt panel bracing bolt holes.
    e. Oil staining by follow-on trades.
    f. Spalling of floor joints.
16. Slab joint fill procedures.
17. Procedure to follow if problems are encountered.

3.4 PRE-ROOFING MEETING:

A. Schedule and administer pre-roof meeting 14 days prior to commencing installation of roofing.

B. Attendance Required:
1. Owner
2. Owner's Representative.
3. Architect.
4. Contractor's Project Manager and Superintendent.
5. Roofing sub-contractor.
6. Roofing membrane manufacturer.
7. Others as appropriate.

C. Suggested Agenda
1. Discuss representative areas of roofing substrates; inspect and discuss condition of substrate, scupper preparations, curbs, penetrations, and other preparatory work performed by other trades.
2. Review structural loading limitations of deck and inspect deck for flatness and for required mechanical fastening.
3. Review roofing system requirements: Drawings, Specifications, and other Contract Documents.
4. Review required submittals, both complete and incomplete.
5. Review preliminary roof inspection reports verifying locations and heights of roof drains, overflow scuppers, sloping of roof deck, and other roof components.
6. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
7. Review required inspection, testing, certifying, and material use accounting procedures.
8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing, and provision of watertight cut-offs.

3.5 CONSTRUCTION OBSERVATION MILESTONES:

A. Contractor to notify Architect 7 days prior to the following construction activities:
   1. Beginning installation of reinforcing steel in the first tilt wall panels.
   2. Beginning installation of the metal roof deck including perimeter decking.
   3. 100% completion of all structural elements.
   4. Office area rough-in of mechanical, plumbing and electrical work prior to closing up walls and ceilings.

3.6 PROGRESS PHOTOGRAPHS

A. Photography Type: Digital; electronic files.

B. Take photographs that apply to work under construction and submit promptly to Owner.
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Site utilities, particularly underground fireline and thrust blocks.
   5. Slab placements in progress.
   6. Structural framing in progress and upon completion.
   7. Enclosure of building, upon completion.

C. Aerial Views:
   1. Provide aerial photographs from four cardinal views monthly.

D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 4 photos per page, each photo labeled with file name; one PDF file per submittal.

3.7 WEBCAM SERVICE

A. Provide a webcam service - OxBlue or equal. Webcam to be on a fixed pole in a location approved by the Owner. Remove pole once service is terminated at project completion.

3.8 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
   1. Submit additional copy to Owner's Representative.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - CLOSEOUT SUBMITTALS.

E. Job delays occasioned by requirement of resubmission of samples, shop drawings and product data not in accord with Contract Documents are Contractor's responsibility and will not be considered valid justification for extension of contract time.

F. Commence no portion of work requiring submittals until submittal has been reviewed by Architect.

3.9 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:
   1. Operation and maintenance data.
   2. Warranties.
   3. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Documents for Review: If hard copy of submittal is sent in lieu of electronic copy:
   1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, one copy to Owner's' Representative, plus two copies that will be retained by Architect.
   2. Larger Sheets, Not Larger Than 30 x 42 inches: Submit the number of opaque reproductions that Contractor requires, one copy to Owner's' Representative, plus two copies that will be retained by Architect.

C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.

D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.11 SUBMITTAL PROCEDURES

A. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

D. Schedule submittals to expedite the Project, and coordinate submission of related items. Contractor to submit a submittal schedule within 30 days of project start.

E. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

F. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

G. Provide space for Contractor and Architect review stamps.

H. When revised for resubmission, identify all changes made since previous submission.

I. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

J. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 3515

LEED REQUIREMENTS

PART 1 GENERAL

1.1 PROJECT GOALS

A. Contractor is not responsible for the application for LEED certification, nor for determination of methods of achieving LEED credits unless specifically so indicated.

B. Many of the LEED credits can be achieved only through intelligent design of the project and are beyond the control of the Contractor. However, certain credits relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to achieving final certification.

C. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.

D. Since Contractor and subcontractors may not be familiar with LEED requirements, this section includes a summary of the products and procedures intended to achieve LEED credits.
   1. Some credits are marked PREREQUISITE; these must be achieved regardless of the level of certification; many are dependent on proper performance by Contractor and subcontractors.
   2. Other credits involve quantifying percentages by weight and cost; these require careful recordkeeping and reporting by the Contractor.
   3. See www.usgbc.org for more information.

1.2 RELATED REQUIREMENTS

A. Sections that include requirements intended to achieve LEED credits include, but are not limited to, the following:

B. Section 01 3516 - LEED Submittal Forms: Procedures for using the forms.
   1. 01 3516.01 - LEED Material Cost Summary; to report material only cost categories for computations necessary for MR Credits 3, 4.1, 4.2, 5.1, 5.2, and 6.
   2. 01 3516.02 - LEED Wood-Containing Product List; for documentation of wood and wood-based products used on project; MR Credit 6.
   3. 01 3516.03 - LEED Metal-Containing Product List; for documentation of steel and other metals used on project; MR Credits 4.1 and 4.2.
   4. 01 3516.04 - LEED New Product Content Form; for content percentages for recycled, rapidly renewable, and certified wood credits, with material cost; MR Credits 4.1, 4.2, and 6; used in conjunction with Wood-Containing and Metal-Containing Product Lists as well as separately.
   5. 01 3516.05 - LEED New Product Source Form; for documenting source of new products; MR Credit 5.1 and 5.2.
   6. 01 3516.07 - LEED Prohibited Content Installer Certification; for each installer to certify compliance with VOC requirements for adhesives and sealants, including duct sealers, and to certify no use of urea-formaldehyde-containing wood products; EQ Credits 4.1 and 4.4.

C. Section 01 5721 - Indoor Air Quality Controls:
   1. Contractor's IAQ management plan and construction procedures; EQ Credit 3.

D. Section 01 6000 - Product Requirements: Overall project requirements for:
   1. Recycled content; MR Credits 4.1 and 4.2.

2. Regionally-sourced products; MR Credits 5.1 and 5.2.
3. Certified (sustainably harvested) wood; MR Credit 6.

E. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: List of product categories having VOC content restrictions, evidence required, and reporting requirements.

F. Section 01 7419 - Construction Waste Management and Disposal:

G. Section 01 7800 - Closeout Submittals:
1. Maintenance and operation manuals for commissioned systems; EA Credit 3.

H. Section 01 9113 - General Commissioning Requirements:

1.3 INFORMATION SOURCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE); 1791 Tullie Circle, NE, Atlanta, GA 30329. Tel: (404) 636-8400. Fax: (404) 321-5478. www.ashrae.org.

B. Bay Area Air Quality Management District (BAAQMD); 939 Ellis Street, San Francisco, California 94109. Tel: (415) 771-6000. www.baaqmd.gov.

C. Center for Resource Solutions (CRS); Presidio Building, 49 P.O. Box 29512, San Francisco, CA 94129. Tel: (415) 561-2100. Fax: (415) 561-2105. www.resource-solutions.org or www.green-e.org.

D. Green Seal; 1001 Connecticut Avenue, NW, Suite 827, Washington, DC 20036-5525. Tel: (202) 872-6400. Fax: (202) 872-4324. www.greenseal.org.

E. South Coast Air Quality Management District (SCAQMD); 21865 E. Copley Drive, Diamond Bar, CA 91765. Tel: (909) 396-2000. www.aqmd.gov.

F. U.S. Green Building Council (USGBC); 1015 18th Street, NW, Suite 805, Washington, DC 20036. Tel: (202) 82-USGBC or (202) 828-7422. Fax: (202) 828-5110. www.usgbc.org.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ELECTRONIC LEED DOCUMENT SUBMITTAL SERVICE

A. Documents submitted for purposes of LEED certification are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, notifies participants, and provides electronic submission to USGBC.
1. The types of submittals for which this service must be used include those for credits that relate to materials, and any others designated by Architect.
2. For credits for which achievement requires substantiation of material type, quantity, and cost, submit receipts showing purchase of materials for this project.
3. Contractor and Architect are required to use this service.
4. It is Contractor's responsibility to submit documents in PDF format.
5. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
6. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
7. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
8. All other specified submittal and document transmission procedures apply, except that

electronic document requirements to not apply to samples or color selection charts.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3516

LEED SUBMITTAL FORMS

1.1 PURPOSE

A. These forms are for the Contractor's use in submitting documentation to be used to determine whether particular credits have been achieved. The cooperation of subcontractors, suppliers, and manufacturers is required.

B. These forms apply to the following LEED Credits:
   1. MR Credits 4.1 and 4.2 - Recycled Content.
   2. MR Credits 5.1 and 5.2 - Regional Materials.
   3. MR Credit 6 - Certified Wood.
   4. IEQ Credit 4 - Low-Emitting Materials.
   5. IEQ Credit 4.1 - Low-Emitting Materials: Adhesives and Sealants.
   6. IEQ Credit 4.2 - Low-Emitting Materials: Composite Wood.

1.2 FORMS

A. 01 3516.01 - LEED Material Cost Summary Form: Certification by Contractor.

B. 01 3516.02 - LEED Wood-Containing Product List: Certification by Contractor.

C. 01 3516.03 - LEED Metal-Containing Product List: Certification by Contractor.

D. 01 3516.04 - LEED New Product Content Form: Including separate reporting of wood, steel, rapidly renewable, and recycled content; data certification by manufacturer of product; cost and quantity certification by Contractor.

E. 01 3516.05 - LEED New Product Source Form: Data certification by manufacturer of product; cost and quantity certification by Contractor.

F. 01 6116.01 - Accessory Material VOC Content Certification Form: Certification by each installer working on project regardless of product type.

1.3 PROCEDURES

A. All LEED submittal forms are to be submitted by Contractor; certifications are to be made by indicated party.

B. Where a LEED Submittal is called for, fill out and submit the appropriate form.
   1. Fill out one form for each different brand name product and each different manufacturer of a lot of commodity products.
   2. Where required attachments are specified, attach the documentation to the back of the form.

C. Each form must be signed by the entity capable of certifying the information.
   1. Certification signatures must be made by an officer of the company.
   2. For products, certification must be made by the manufacturer not the supplier.
   3. For custom fabricated products, certification by the fabricator is acceptable.

D. Submit the completed forms in accordance with the requirements of Section 01 3000 - Administrative Requirements, as information submittals.
   1. Give each form a unique submittal number.
   2. Do not combine LEED forms with product data or shop drawing submittals.

END OF SECTION

SECTION 01 3516.01

LEED MATERIAL COST SUMMARY FORM

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____

B. This form applies to the following LEED Credits:
   1. MR Credits 3 - Materials Reuse.
   2. MR Credits 4.1 and 4.2 - Recycled Content.
   3. MR Credits 5.1 and 5.2 - Regional Materials.
   4. MR Credit 6 - Certified Wood.

C. Procedure:
   1. Because the above listed credits require computations based on the material costs for the project, the Contractor is required to submit the following cost breakdown, in addition to any cost breakdown specified elsewhere.
   2. Costs are to be material costs excluding labor, overhead, and profit, but including delivery, storage, and handling charges. Revise cost summary whenever materials actually installed change due to contract modifications or Contractor preference.

1.2 CERTIFICATION

1.3 $ _____ TOTAL COST OF ALL MATERIALS

1.4 $ _____ TOTAL COST OF PLUMBING, HVAC, ELECTRICAL, AND COMMUNICATIONS

1.5 $ _____ TOTAL COST OF ARCHITECTURAL EQUIPMENT IN DIVISIONS 11 THROUGH 14

1.6 $ _____ TOTAL COST OF WOOD AND WOOD-BASED MATERIALS, INCLUDING ONLY PERMANENTLY INSTALLED WOOD PRODUCTS.

1.7 CERTIFIED BY: (CONTRACTOR)

A. Print Name: _____

B. Signature: _____

C. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 3516.02

LEED WOOD-CONTAINING PRODUCT LIST

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____

B. This form applies to LEED MR Credit 6 (certified wood).

1.2 WOOD-CONTAINING PRODUCTS

A. Wood-containing products are those made of solid wood, wood chip, or wood fiber, or containing components made of solid wood, wood chip, or wood fiber.

B. Rationale: Because the computation for this credit is based on the total material costs for all wood and wood-based products on the project, the Contractor is required to submit the following itemization of wood and wood-based products, including materials used during construction but not incorporated into the finished work.

C. Procedure: For each permanently installed wood-containing product provided for this project, submit "LEED Material Content Form". At minimum, submit for the following products. Initial those for which the material content form is attached.

D. Permanent Wood-Containing Product List:
   1. ___ Wood framing, furring, and supports
   2. ___ Sheathing
   3. ___ Blocking, curbing, and nailers

1.3 CERTIFICATION

A. ___ All other wood-containing products used on this project are shown on the attached list.

B. ___ I certify that there are no other wood-containing products used on this project that exceed 1 percent of total material cost.

C. ___ I certify that there are no other temporary facilities or construction using wood-containing products that exceed 1 percent of the total material cost.

D. CERTIFIED BY: (Contractor)
   1. Print Name: _____
   2. Signature: _____
   3. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 3516.03

LEED METAL-CONTAINING PRODUCT LIST

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____

B. This form applies to LEED Credits MR 4.1 and 4.2 (recycled content).

1.2 STEEL-CONTAINING PRODUCTS

A. Rationale: Although all steel contains reused steel, steel products often cannot be traced to a certain mill lot and, even when they can, the mill's certificate usually does not indicate the proportion of new to reused steel.

B. Procedure: Determine recycled steel content by estimating the proportion of reused steel based on trade association surveys of mill practices multiplied by the quantity of steel by weight in the product.
   1. Referenced Mill Practices Survey: See the current edition of Steel Recycling Institute "Steel Takes LEED with Recycled Content," at http://www.recycle-steel.org/PDFs/leed/Steel%20Takes%20LEED_June06.pdf.
   2. If the mill source cannot be identified, the product will be considered to have the lowest reused steel content reported in referenced mill practices survey.
   3. For each steel-containing product provided for this project, submit "LEED New Product Content Form". At minimum, submit for the following products. Initial those for which the material content form is attached.

C. Steel-Containing Product List:
   1. ___ Concrete reinforcement (bars, mats, wire, mesh), anchor plates.
   2. ___ Structural steel framing members, plates.
   3. ___ Miscellaneous steel fabrications made from rolled shapes, including equipment supports.
   4. ___ Bar joists and girders.
   5. ___ Steel decking.
   6. ___ Steel stairs and ladders.
   7. ___ Steel handrails and railings.

1.3 CERTIFICATION

A. ___ All other steel- and cast iron-containing products used on this project are shown on the attached list.

B. ___ I certify that there are no other steel-containing products used on this project that exceed 1 percent of total material cost less material cost attributed to mechanical and electrical.

C. CERTIFIED BY: (Contractor)
   1. Print Name: _____
   2. Signature: _____
   3. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 3516.04

LEED MATERIAL CONTENT FORM

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____
   4. Product Name: _____ (brand name, model number, etc.)
   5. Manufacturer: _____www._____
      a. Contact: _____tel:_____
   6. Supplier/Sub: _____www._____
      a. Contact: _____tel:_____
   7. Applicable Specification Section Number(s) _____

B. This form applies to LEED Credits MR 4.1 and 4.2 (recycled content) and MR 6 (certified wood).

1.2 PRODUCT CERTIFICATION

A. Total Weight: _____ per _____ (unit).

B. CERTIFIED BY: (Manufacturer)
   1. Print Name: _____
   2. Signature: _____
   3. Title: _____ (officer of company), Date: _____

1.3 COST CERTIFICATION

A. Unit Cost: $ _____ per _____ (same unit as above); No. of Units Installed: _____

B. OR (enter cost either above or below, not both)

C. Total Installed Material Cost of This Product: $ _____

D. CERTIFIED BY: (Contractor)
   1. Print Name: _____
   2. Signature: _____
   3. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 3516.05

LEED NEW PRODUCT SOURCE FORM

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____
   4. Product Name: _____ (brand name, model number, etc.)
   5. Manufacturer: _____ www._____
      a. Contact: _____ tel:_____
   6. Supplier/Sub: _____ www._____
      a. Contact: _____ tel:_____
   7. Applicable Specification Section Number(s) _____

B. This form applies to LEED MR Credits 5.1 and 5.2 for new products only; see separate form for reused products.

1.2 PRODUCT CERTIFICATION

A. The following percentages of this product were processed in the locations indicated. (Indicate N/A in first column if process is not applicable.)

Percent	Harvest, Extraction, Recovery, or Manufacturing Process	City/County, State, Country	Distance From Project
____ %	Raw Material _____:	_____	_____
____ %	Raw Material _____:	_____	_____
____ %	Raw Material _____:	_____	_____
____ %	Manufactured at: (primary)	_____	_____
____ %	Manufactured at: (primary)	_____	_____
____ %	Manufactured at: (secondary)	_____	_____
____ %	Manufactured at: (secondary)	_____	_____
____ %	Manufactured at: (final)	_____	_____
____ %	Manufactured at: (final)	_____	_____

B. CERTIFIED BY: (Manufacturer)
   1. Print Name: _____
   2. Signature: _____
   3. Title: _____ (officer of company), Date: _____

1.3 COST CERTIFICATION

A. Unit Cost: $ _____ per _____ (unit); No. of Units Installed: _____

B. OR (enter cost either above or below, not both)

C. Total Installed Material Cost: $ _____

D. CERTIFIED BY: (Contractor)

1. Print Name: _____
2. Signature: _____
3. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 3516.07

LEED PROHIBITED CONTENT INSTALLER CERTIFICATION

1.1 LEED SUBMITTAL FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____

B. This form applies to the following LEED credits:
   1. Credit IEQ 4.1; VOC content of field-installed adhesives and sealants.
   2. Credit IEQ 4.4; added-urea-formaldehyde content of composite wood and agrifiber products, defined as particleboard, plywood, medium density fiberboard, wheatboard, strawboard, panel substrates, door cores, and laminating adhesives; applies to manufacturers/suppliers and installers.

C. Procedure:
   1. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, each installer of work on this project is required to certify that his/their use of these particular materials complies with the contract documents and to provide documentation showing that the products used do not contain the prohibited content.
   2. Volatile organic compounds (VOCs) are defined by the U.S. EPA and state and local regulations applicable to this project. See Contract Documents for minimum criteria.

1.2 PRODUCT CERTIFICATION

A. ____ Adhesives: I certify that the installation work of my firm on this project has not required the use of any adhesives.

B. OR (certify either the above or the below, not both)

C. ____ Adhesives: I certify that my firm has NOT installed any adhesive with VOC content exceeding that specified in Section 01600 on this project; product data and MSDS sheets for all adhesives used, whether specified or not, are attached.

D. ____ Joint Sealants: I certify that the installation work of my firm on this project has not required the use of any gunnable or pourable joint sealants.

E. OR (certify either the above or the below, not both)

F. ____ Joint Sealants: I certify that my firm has NOT installed any joint sealant with VOC content exceeding that specified in Section 07900 on this project; product data and MSDS sheets for all joint sealants used, whether specified or not, are attached.

G. ____ Composite Wood and Agrifiber Products: I certify that the work of my firm on this project has not required the use of any composite wood or agrifiber products, as defined above.

H. OR (certify either the above or the below, not both)

I. ____ Composite Wood and Agrifiber Products: I certify that the composite wood and agrifiber products, as defined above, furnished or installed by my firm DO NOT contain any ADDED urea-formaldehyde binder; product data and MSDS sheets for products used, whether specified or not, are attached.

J. CERTIFIED BY: (Installer/Manufacturer/Supplier Firm)
   1. Firm Name: _____
   2. Print Name: _____
   3. Signature: _____
   4. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References and standards.

B. Control of installation.

C. Testing and inspection services.

D. Manufacturers' field services.

1.2 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.3 REFERENCE STANDARDS

A. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2011c.

B. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2012.

C. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.

D. ASTM E329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2011.

E. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2009.

1.4 TESTING AND INSPECTION AGENCIES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection.
   1. Soils compaction.
   2. Paving (Concrete/Asphalt)
   3. Concrete Testing and Placement, (including Tilt-Up Wall Panels).
   4. Foundations
   5. Reinforcing steel.
   6. Floor flatness and levelness.
   7. Masonry
   8. Structural steel welds.
   9. Structural bolts.
   10. Metal deck attachments.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

C. Testing Agency Requirements:
   1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1077, and ASTM C1093.
   2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.

3. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.
4. Reports of all tests shall be signed by a qualified individual, having professional registration in the state in which the project is being constructed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Attend preconstruction meetings and progress meetings as required.
   7. Testing Agency shall promptly process and distribute all copies of test reports and related instructions to insure that all necessary retesting and/or replacement of materials can be accomplished without possible delay to progress of the work. The Testing Agency shall provide a written report within three (3) days related to every project test and inspection. Distribute copies to each of the following:
      a. Owner
      b. Architect
      c. Structural Engineer
      d. Contractor
      e. Building Official (if required)

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Provide Testing Agency with copies of the following shop drawings prior to start of work:
a. Asphalt mix designs.
b. Concrete mix designs.
c. Masonry grout/mortar mix designs.
d. Structural including steel, reinforcing, masonry.
e. Roofing shop drawings.
3. Cooperate with laboratory personnel, and provide access to the Work.
4. Provide incidental labor and facilities:
a. To provide access to Work to be tested/inspected.
b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.
5. Notify the Testing Agency a minimum of 48 hours in advance of operations to allow for Testing Agency assignment of personnel and scheduling of tests.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

F. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.3 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.4 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Security requirements.

E. Vehicular access and parking.

F. Waste removal facilities and services.

G. Project identification sign.

H. Field offices.

1.2 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

B. Provide temporary electrical service, including extensions and connections necessary for construction work. Pay costs of installing and maintaining service for duration of project. Pay costs associated with use of permanent electrical system until Date of Substantial Completion.

C. Temporary Heat and Ventilation:
   1. Provide adequate heat and ventilation required to properly complete and install all work.
   2. Provide humidity control in work and finished areas to permit proper installation and maintenance of finished work.
   3. Provide ventilation to prevent accumulation of dust, fumes or gases; to properly cure materials and disperse humidity.

D. Provide temporary water for construction purposes, including extensions and connections necessary for work. Pay costs of installing and maintaining service for duration of project. Pay costs associated with use of permanent water system until Date of Substantial Completion.

1.3 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for local telephone service to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Telephone Land Lines: One line, minimum; one handset per line.
   2. Internet Connections: Minimum of one; DSL modem or faster. Minimum 6MB speed.

1.4 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. New permanent facilities may not be used during construction operations.

C. Maintain daily in clean and sanitary condition.

1.5 SAFEGUARDS DURING CONSTRUCTION:

A. Construct and maintain in accord with local building codes and OSHA regulations.

B. Temporary Controls: determine methods and procedures to be used and assume responsibility for proper protection and safety of all personnel, site, adjoining areas and structures, and public during all phases of the work. Provide all necessary boarding and fencing around all open excavation as required by applicable codes, by-laws, or governing authorities.

C. Barriers: Contractor shall be responsible for complete and proper protection from damage of existing buildings, improvements and existing parts of work to remain. Provide and maintain at all times suitable temporary barriers, partitions, and signs as necessary.

1.6 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Provide and maintain temporary roadways as required to construct the Work.

1.7 WASTE REMOVAL

A. See Section 01 7419 - Waste Management, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

1.8 PROJECT IDENTIFICATION

A. Construct a project sign of 3/4" thick AC plywood, approximately 4'-0" x 8'-0" painted in not more than four (4) colors, supported by 4" x 4" wood posts buried in ground 3'-0" minimum. Coordinate sign design with Architect.

B. Erect on site at location established by Architect.

C. No other signs are allowed without Owner permission except those required by law.

1.9 FIELD OFFICES

A. Contractor Trailer: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture.

B. Provide space for Project meetings with table and chairs to accommodate 10 persons minimum.

C. Owner's Representative Trailer: Provide separate trailer similarly equipped and furnished, for use of Owner's Representative.

1.10 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Relocate temporary facilities during soncstruction as required by progress of the Work at no additional cost to the Owner.

B. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 5721

INDOOR AIR QUALITY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality after construction.

1.2 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
   1. Cleaning of ductwork is not contemplated under this Contract.
   2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
   1. Furnish products meeting the specifications.
   2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.3 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. LEED Submittals: Submit all submittals required in this section in accordance with procedures specified in Section 01 3515.

C. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for Occupied Buildings Under Construction as a guide.
   1. Submit not less than 60 days before enclosure of building.
   2. Identify potential sources of odor and dust.
   3. Identify construction activities likely to produce odor or dust.
   4. Identify areas of project potentially affected, especially occupied areas.
   5. Evaluate potential problems by severity and describe methods of control.
   6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
   7. Describe cleaning and dust control procedures.

D. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate

air handling zone, sequence of application, and curing times.

PART 2 PRODUCTS

2.1 MATERIALS

A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Begin construction ventilation when building is substantially enclosed.

C. HVAC equipment and supply air ductwork may be used for ventilation during construction:
   1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
   2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
   3. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air; provide alternate return air pathways.

D. Do not store construction materials or waste in mechanical or electrical rooms.

E. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Clean return plenums of air handling units.
   6. Remove intake filters last, after cleaning is complete.

F. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

G. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

END OF SECTION

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations and procedures.

E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Product quality monitoring.

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

PART 2 PRODUCTS

2.1 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. Sustainably Harvested Wood:
   1. Definition: Wood-based materials include but are not limited to structural framing, dimension lumber, flooring, wood doors, finishes, and furnishings that are permanently installed in the project. Wood and wood-based products not permanently installed in the project are not included in the definition.
   2. Specific Wood-Based Fabrications: Fabricate of sustainably harvested wood when so specified elsewhere.
   3. Certification: Provide wood certified or labeled by an organization accredited by one of the following:
      a. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit http://www.fsccanada.org, for the USA visit http://www.fscus.org.
   4. LEED Submittals: State unit cost of each wood-based item, quantity installed, quantity certified as sustainably harvested, total wood-based material cost, and total sustainably harvested value; provide letter of certification signed by supplier of each item, indicating compliance with the specified requirements and identifying the certifying organization.
      a. Include the certifying organization's certification numbers for each certified product, itemized on a line-item basis.
      b. Attach copies of invoices bearing the certifying organization's certification numbers.

2.2 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
   1. The burden of proving equality of a proposed substitute to an item designated by trade name or by manufacturer's name in the contract documents rests on the party submitting the request for approval.

2.3 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
   1. If the submittal is approved by the Architect, an Addendum will be issued to all prospective bidders at least three days prior to the bid date.
   2. Unless requests for changes are received and approvals are published by Addendum in accordance with the above procedure, the successful bidder shall be held responsible for furnishing items and materials of the trade names or manufacturer's names called for in the specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

D. Requests for substitutions shall include the following data:
   1. Date of request.
   2. Project name.
   3. Specification reference.
   4. Specified item.
   5. Proposed substitution.
   6. Manufacturer.
   7. Deviations from the specified item.
   8. Manufacturer's recommendations for use and installation. Submit drawings if required for clarity.
   9. A complete schedule of changes in the drawings and specifications, if any, which must be made in other work in order to permit the use and installation of the proposed substitute in accordance with the recommendations of the manufacturer of the product.
   10. Technical data to support request for approval. List reference standards met, submit testing laboratory reports and experience records.
   11. Other supporting data such as brochures, samples and drawings.
   12. Samples or product literature of specified product for comparison, if requested by Architect.

E. Determination as to acceptability of proposed substitution shall be made based only on data

submitted.

3.2 TRANSPORTATION AND HANDLING

A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

3.3 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Prevent contact with material that may cause corrosion, discoloration, or staining.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 6116

VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. VOC restrictions for product categories listed below under "DEFINITIONS."

B. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.2 RELATED REQUIREMENTS

A. Section 01 3515 - LEED Certification Procedures.

B. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.3 DEFINITIONS

A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
   1. Adhesives, sealants, and sealer coatings.
   2. Carpet.
   3. Carpet tile.
   4. Paints and coatings.
   5. Cabinet work.
   6. Composite wood and agrifiber products used either alone or as part of another product.
   7. Other products when specifically stated in the specifications.

B. Interior of Building: Anywhere inside the exterior weather barrier.

C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.4 REFERENCE STANDARDS

A. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute; Current Edition.

B. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc.; 2011.

C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Evidence of Compliance: Submit for each different product in each applicable category.
   1. Identify evidence submittals with the words "LEED Report".

C. Product Data: For each VOC-restricted product used in the project, submit product data showing compliance, except when another type of evidence of compliance is required.

D. Installer Certifications for Accessory Materials: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of his products, or 2) that such products used comply with these requirements.
   1. Use the form following this section for installer certifications.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.

B. Joint Sealants: Provide products having VOC content as specified in Section 07 9005.

C. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current GreenSeal Certification.

D. Paints and Coatings: Provide products having VOC content as specified in Section 09 9000.

E. Carpet and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current Green Label Plus Certification.
      b. Report of laboratory testing performed in accordance with requirements.

F. Carpet Tile and Adhesive: Provide products having VOC content as specified in Section 09 6813.

G. Composite Wood and Agrifiber Products and Adhesives Used for Laminating Them: Provide products having no added urea-formaldehyde resins.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Published product data showing compliance with requirements.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. All additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 6116.01

ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM

1.1 FORM

A. Identification:
   1. Project Name: _____
   2. Project No.: _____
   3. Architect: _____

B. Use of This Form:
   1. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, there is a possibility that such accessory materials might contain VOC content in excess of that permitted, especially where such materials have not been explicitly specified.
   2. Contractor is required to obtain and submit this form from each installer of work on this project.
   3. For each product category listed, circle the correct words in brackets: either [HAS] or [HAS NOT].
   4. If any of these accessory materials has been used, attach to this form product data and MSDS sheet for each such product.

C. VOC content restrictions are specified in Section 01 6116.

2.1 PRODUCT CERTIFICATION

A. I certify that the installation work of my firm on this project:
   1. [HAS] [HAS NOT] required the use of any ADHESIVES.
   2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
   3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
   4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.

B. Product data and MSDS sheets are attached.

3.1 CERTIFIED BY: (INSTALLER/MANUFACTURER/SUPPLIER FIRM)

A. Firm Name: _____

B. Print Name: _____

C. Signature: _____

D. Title: _____ (officer of company)

E. Date: _____

END OF SECTION

SECTION 01 7000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surveying for laying out the work.

B. Cleaning and protection.

C. Starting of systems and equipment.

D. Demonstration and instruction of Owner personnel.

E. Closeout procedures, except payment procedures.

1.2 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures.

B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties.

1.3 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water.

B. Contractor shall endeavor to keep the site free from unnecessary damage from rain, surface or subsurface water. Water shall not be allowed to accumulate in excavations or under or about the structures. The Contractor at the end of each day should seal the site so that it drains and ensure that areas do not exist which would hold water. Should such conditions develop or be encountered, the water shall be kept constantly controlled and legally disposed of by temporary pumps, piping, ditches, dams or other methods.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.4 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Utilize recognized engineering survey practices.

E. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

F. Periodically verify layouts by same means.

G. Maintain a complete and accurate log of control and survey work as it progresses.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.3 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.4 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.5 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.6 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.7 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.8 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, and drainage systems.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. All concrete curb and gutter and concrete pavement and walks shall be pressure cleaned during final clean-up.

J. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.9 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Notify Architect when work is considered ready for Substantial Completion.

C. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.

D. Notify Architect when work is considered finally complete.

E. Complete items of work determined by Architect's final inspection.

END OF SECTION

SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

E. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Recycled and Salvaged Materials: Include the following information for each:
      a. Identification of material, including those retrieved by installer for use on other projects.
      b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
      c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      e. Certification by receiving party that materials will not be disposed of in landfills or

by incineration.

5. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards.
   c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Pre-bid meeting.
   2. Pre-construction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 7800

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

A. Upon receiving the Certificate of Substantial Completion, Contractor shall prepare, assemble and transmit the items listed herein within ten days.
   1. Project Record Documents:
      a. Submit one complete set of shop drawings to Owner.
      b. Submit one copy of the record drawings to Architect for review.
   2. Operation and Maintenance Data: Submit three copies of the O&M manuals to Architect for review.
   3. Warranties and Bonds: Submit three copies of the warranties and bonds to Architect for review.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings and Shop Drawings: On a complete set of prints, legibly mark each item to

record actual construction including:

1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE MANUALS

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

B. Prepare data in the form of an instructional manual.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

F. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

G. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. List of equipment.
      b. Parts list for each component.
      c. Operating instructions.
      d. Maintenance instructions for equipment and systems.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Photocopies of warranties and bonds.

3.3 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

D. Manual: Bind in commercial quality 8-1/2 by 11 inch binders with durable plastic covers.

END OF SECTION

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. Landscape irrigation system.
   3. Loading dock equipment.
   4. HVAC systems and controls.
   5. Plumbing equipment.
   6. Electrical power distribution and equipment.
   7. Electrical lighting controls.
   8. Fire protection system and fire pump.
   9. Emergency generator.
   10. Fire alarm system.
   11. Motorized gates and traffic arms.

1.2 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.3 SUBMITTALS

A. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations within two weeks after Substantial Completion.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations within two weeks after Substantial Completion.

3.2 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Provide training in minimum two hour segments.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 01 9113

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion

C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

D. The Commissioning Authority is employed by Owner.

1.2 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. Plumbing Systems:
   1. Water heaters.
   2. Booster pumps.
   3. Landscape irrigation.

C. HVAC System, including:
   1. Major and minor equipment items.
   2. Control system.

D. Electrical Systems:
   1. Emergency power systems.
   2. Lighting controls other than manual switches.

1.3 RELATED REQUIREMENTS

A. Section 01 3515 - LEED Certification Procedures: LEED credits relating to commissioning.

B. Section 01 7800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

C. Section 01 7900 - Demonstration and Training: Scope and procedures for Owner personnel training.

1.4 REFERENCE STANDARDS

A. PECI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Portland Energy Conservation, Inc.; located at http://www.peci.org/library/mcpgs.htm; current edition.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2003 preferred.
   5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
   6. LEED Submittals: Submit approved submittals in accordance with procedures specified in Section 01 3515.

B. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.

C. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
   1. Manufacturer's product data, cut sheets, and shop drawings.
   2. Manufacturer's installation instructions.
   3. Startup, operating, and troubleshooting procedures.
   4. Fan and pump curves.
   5. Factory test reports.
   6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.

D. Startup Plans and Reports.

E. Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
   1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
   2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
   3. Calibration: According to the manufacturer’s recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments

as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
   1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.1 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.
   1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
   2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Commissioning Schedule:
   1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
   2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
   3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
   4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.2 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.3 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   1. No sampling of identical or near-identical items is allowed.
   2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
   3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
      a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
      b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
      c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."

d. Serial number of installed unit.
e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
f. Sensor and actuator calibration information.

4. Samples of Prefunctional Checklist forms that indicate anticipated level of detail can be found at http://www.peci.org/library/mcpgs.htm.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
4. If any Checklist line item is not relevant, record reasons on the form.
5. Contractor may independently perform startup inspections and/or tests, at his option.
6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Commissioning Authority within two days of completion.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.4 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional

Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
   1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
   2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
   3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
   4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
   5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
   1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
   2. Examples of Functional Testing:
      a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
      b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
      c. Systems are run through all the HVAC control system’s sequences of operation and components are verified to be responding as the sequence's state.
      d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
   3. Samples of Functional Test forms that indicate anticipated level of detail can be found at http://www.peci.org/library/mcpgs.htm.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.5 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration

certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
   1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
   2. Verify that sensors with shielded cable are grounded only at one end.
   3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
   4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
   1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
   3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
   1. Disconnect sensor.
   2. Connect a signal generator in place of sensor.
   3. Connect ammeter in series between transmitter and building automation system control panel.
   4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
   5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
   6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
   7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
   8. Reconnect sensor.
   9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
   10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
   11. If not, replace sensor and repeat.
   12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
   1. Watthour, Voltage, Amperage: 1 percent of design.
   2. Pressure, Air, Water, Gas: 3 percent of design.
   3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
   4. Relative Humidity: 4 percent of design.
   5. Barometric Pressure: 0.1 inch of Hg.
   6. Flow Rate, Air: 10 percent of design.
   7. Flow Rate, Water: 4 percent of design.
   8. AHU Wet Bulb and Dew Point: 2.0 degrees F.

G. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust

output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

H. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.6 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
2. Sampling is not allowed for:
   a. Major equipment.
   b. Life-safety-critical equipment.
   c. Prefunctional Checklist execution.
3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
7. If YY percent of the units in the second sample fail, test all remaining identical units.
8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect

indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
   1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
   2. Other points will be monitored by the Commissioning Authority using dataloggers.
   3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
   4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
   5. Graphical output is desirable and is required for all output if the system can produce it.
   6. Monitoring may be used to augment manual testing.

3.7 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 7800 for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 02 3200

SUBSURFACE CONDITIONS

PART 1 - GENERAL

1.1 EXISTING CONDITIONS:

A. The Contractor shall visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedule and arrangements approved in advance by the Owner.

1.2 SUBSURFACE CONDITIONS:

A. A subsurface investigation report obtained for use in the design of pavement and foundations is attached herein.
   1. Contractor shall assume responsibility for any conclusions drawn from the data.
   2. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner and his consultants will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.
   3. Data are made available only for the convenience of Contractor. The Contractor shall perform any additional subsurface investigation necessary to completely familiarize and satisfy himself as to the existing conditions at no cost to the Owner.
   4. The Contractor should visit the site and acquaint himself with the site conditions.

END OF SECTION 02010

SECTION 03 1000

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.2 RELATED REQUIREMENTS

A. Section 031500 - Slab on Ground Accessories: Dowel plates and plate baskets.

B. Section 03 2000 - Concrete Reinforcing.

C. Section 03 3000 - Cast-in-Place Concrete.

D. Section 05 1200 - Structural Steel: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.3 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute; 2010.

C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute; 2011.

D. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute; 2004.

E. PS 1 - Structural Plywood; 2009.

1.4 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to code requirements; resultant concrete to conform to required shape, line and dimension.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 347, ACI 301, and ACI 318.

PART 2 PRODUCTS

2.1 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.

C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

2.2 WOOD FORM MATERIALS

A. Softwood Plywood: PS 1, C Grade, Group 2.

B. Lumber: Southern yellow pine species; No 2 grade; with grade stamp clearly visible.

2.3 REMOVABLE PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

2.4 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

C. Form Release Agent: Colorless mineral oil that will not stain concrete.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 1200.

F. Waterstops: Preformed mineral colloid strips, 3/8 inch thick, moisture expanding.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Except for floor slabs, construct bulkheads with keys at separation of pours except as otherwise noted on drawings. Locations of bulkheads shall be as indicated on approved shop drawings.

F. Slab on Grade Edge Forms: Wood bulkheads for slab forms shall be cut true and straight with an angled top surface tapering down and away from slab at a 15 degree angle. Use of stryofoam blocks as a slab edge form shall not be permitted.

G. Coordinate this section with other sections of work that require attachment of components to formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.4 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Locate and set in place items that will be cast directly into concrete.

B. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

C. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.

3.5 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.6 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION

SECTION 03 1500

SLAB ON GROUND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes slab on ground dowel system.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED New Product Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 03 3000 - Cast-in-Place Concrete

1.3 REFERENCE STANDARDS

A. ACI 360 - Design of Slabs-on-Ground; American Concrete Institute International; 2006

1.4 SUBMITTALS

A. Product Data: Provide product data on all products including manufacturers installation requirements.

B. Reports: Independent pull-out testing of the debonding agent must demonstrate a required pull-out force of less than 1,000 lbs per load plate.

C. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content furnished under this section.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Acceptable manufacturers:
   1. PNA Construction Technologies
   2. No Substitutions.

2.2 MATERIALS:

A. Smooth plate bars, manufactured from steel meeting ASTM A 36.

B. Load plates must have smooth and true edges. Acceptable methods of manufacture are saw or plasma cut and deburred. If sheared, manufacture must demonstrate that all edges will be deburred, and smooth and true without any deformity that may induce restraint of the slab.

2.3 CONSTRUCTION JOINT DOWELS:

A. All formed construction joints at the slab-on-grade shall be doweled.

B. Acceptable Products:
   1. PNA Construction Technologies (800-542-0214): Diamond Dowel Plates.
      a. Diamond Dowel Plate: 1/4 x 4-1/2 x 4-1/2 inch steel plate for 6 inch slab. 3/8 x 4-1/2 x 4-1/2 inch steel plate for 10 inch slab.

b. Spacing: 24 inch on center for 6 inch slab and 18 inch on center for 10 inch slab.
c. Accessory: High density plastic pocket former.

2.4 SAWN CONTROL JOINT DOWEL BASKETS:

A. All sawn control joints at the slab-on-grade shall incorporate dowel baskets.

B. Acceptable Products:
1. PNA Construction Technologies (800-542-0214):
a. PD3 Tapered Plate Dowels: 3/8 x 2 x 12 inch steel plate for 6 inch slab.
b. Spacing: 19 inch on center.

C. Basket: Fully welded wire basket assembly, fabricated from 1/4 inch diameter cold drawn wire. Eight gauge wires shall be welded across the side frames at approximately 3 feet on center to keep the assembly stable during shipping and installation.. Dimensions as required to locate dowel at mid-point of slab.

D. The load plates shall be delivered to the jobsite with a thin and consistently applied debonding agent of a maximum thickness of 0.002 inch. Greasing plates in the field is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Slab on Ground Dowels:
1. Place all joint reinforcement products in accordance with the manufacturer's installation details, utilizing all alignment tools available.
2. Install dowels perpendicular to joint and parallel to finished concrete surface.
3. Dowel alignment shall be within ACI 117 tolerance allowance.
4. Do not grease plate dowels.

3.2 CONSTRUCTION JOINTS

A. Mark center point for spacing of each load plate on top of wood form along entire length. Set forms along construction joints. Place pocket former up to within 6 inches of joint intersection and a maximum of 12 inches to ensure positive load transfer at all joint intersections.

B. Install plastic pocket former sleeve insert to slab edge form at mid slab depth using the installation template included in each box of Diamond Dowel® pocket formers or the Diamond Dowel® bulkhead that can be purchased independently from PNA. After the form is removed, insert steel plate prior to adjacent slab pour.

C. Insert load plate into slot created by pocket former. Center corner of plate in middle of label and push straight through label into pocket former. Do not hammer or use excessive force to insert load plate. Insert load plate within three days of concrete placement.

3.3 SAWN CONTROL JOINTS:

A. Locate control lines on sub-base prior to slab pour for accurate placement of plate basket assembly, centered on joint. Basket shall be fabricated to place load plate at mid slab depth. Do not cut temporary cross wires.

B. Baskets shall be fully welded assemblies fabricated to best suit the joint layout. Assemblies that require more than 5 percent of the assemblies to be cut onsite will not be allowed. No basket with less than 3 plates should be used.

C. The number of load plates in the welded assembly at the specified spacing must place the end load plates as close as possible to 6 inches from the joint intersection and in no instance more than 18 inches from the joint intersection.

D. Stake baskets securely in place to prevent shifting during concrete placement. Basket assemblies placed on vapor retarders must be staked to ensure positive alignment during construction. The stakes shall be installed through mastic to maintain the integrity of the vapor retarder.

3.4 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01400, will inspect installed accessories for conformance to contract documents before concrete placement.

B. Manufacturers technical representative shall be present at first slab placement to verify accessories have been installed according to manufacturer's approved specifications and details.

END OF SECTION

SECTION 03 2000

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED New Product Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 03 1000 - Concrete Forming and Accessories.

E. Section 03 1500 - Slab On Ground Accessories.

F. Section 03 3000 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2011.

C. ACI 360 - Design of Slabs-on-Ground; American Concrete Institute International; 2006

D. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

E. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.

G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2009.

1.4 SUBMITTALS

A. Shop Drawings: Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

D. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content furnished under this section.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M Grade 60 (420).
   1. Deformed billet-steel bars.

B. Stirrup Steel: ASTM A82/A82M steel wire, unfinished.

C. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
   1. Mesh Size and Wire Gage: As indicated on drawings.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.2 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice and ACI 318.

B. Welding of reinforcement is not permitted.

PART 3 EXECUTION

3.1 PLACEMENT

A. Reinforcement, at the time concrete is placed, shall be free from rust scale, oil and other coatings reducing bond. Use no bars with kinks or bends not shown on placement drawings.

B. Place, support and secure reinforcement against displacement. Do not deviate from required position.

C. Accommodate placement of formed openings.

D. Protective concrete cover over reinforcement shall be as indicated on the drawings.

E. Install wire mesh reinforcement in sizes and locations indicated. Lap joints one wire spacing plus 2".

F. Conduit and Pipes: Concrete cover shall be equal to cover for reinforcing bars. Embedded conduit diameter shall not exceed 1/3 slab or wall thickness. Tie down low conduit on top of bottom reinforcing bars. Space no conduit less than three diameters apart and minimum 1" separation from parallel reinforcing bars. Use no aluminum conduits or couplings in concrete

3.2 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete foundations.

B. Concrete floor slabs on grade.

C. Concrete tilt-up wall panels.

D. Joint devices associated with concrete work.

E. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, and barrier arm motors.

F. Concrete curing.

G. Crack repair of concrete floor slabs.

1.2 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 01 3516.05 - LEED New Product Source Form.

C. Section 01 4000 - Quality Requirements: Testing and inspection.

D. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.

E. Section 03 1500 - Slab-On-Ground Accessories.

F. Section 03 2000 - Concrete Reinforcing.

G. Section 03 3511 - Concrete Floor Finishes.

H. Section 03 4713 - Tilt-Up Concrete

I. Section 07 2600 - Vapor Retarder.

1.3 REFERENCE STANDARDS

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International; 2010.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

C. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; American Concrete Institute International; 1998 (Reapproved 2004).

D. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

E. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (errata 2007).

F. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

G. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

H. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.

I. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).

J. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.

K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a.

L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012a.

M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2012.

N. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2010a.

O. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

P. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2012.

R. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2008).

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Mix Designs: Submit mix designs for each type and class of concrete to Testing Agency for their approval. Approved mix designs shall then be submitted to the Architect.
   1. Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials.
   2. Sieve Analysis Reports: Provide separate sieve analysis of percentages passing for coarse and fine aggregate. Show values for each sieve size shown on the mix design form. Do not leave any line blank. Sieve analysis sampling and testing for each aggregate source shall be conducted within 60 days of concrete submittal date.
   3. Aggregate Supplier Statement;
      a. Stating if aggregate is possibly alkali-reactive, based on tests or past service.
      b. Stating if aggregate can possibly cause pop-outs, "D" cracking, or other disruptions due to moisture gain, freezing, or other mechanisms, based on tests or past service.

C. Placing Drawings: Provide placing plan depicting layout and sequencing of slab pours for Owner approval. Include horizontal and vertical construction joint locations, control joint spacing, temporary block-outs and openings for equipment access.

D. Pre-qualify ready-mixed concrete suppliers according to the requirements of ASTM C94.

E. LEED Reports: Submit letter indicating source of raw materials and location.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Acquire cement from same source and aggregate from same source for entire project.

C. It shall be the responsibility of the Contractor to produce concrete slabs of the strength, durability, workability and specified finish.

D. Allowable Tolerances:
   1. Formwork: Conform to most stringent requirements of ACI 117 and ACI 301, except as specified herein.
   2. Slab on ground shall conform to ACI 117, unless noted otherwise.
   3. Slab on Ground Base Fine Grade: +/- 3/8 inch, with transition no greater than 3/4 inch vertically to 8 inches horizontally for level slab.
   4. Concrete floor slabs shall have cross-sectional dimensional tolerance as follows:
      a. Minimum Average Thickness = T-1/4 inch where T is the specified nominal thickness.
      b. Maximum Standard Deviation = 3/8 inch.
   5. Thickness samples are to be randomly located from each slab placement and not exceed 20,000 square feet of slab surface area.
   6. RANDOM TRAFFIC FLOORS:
      a. All slabs in the Low Bay Area and Shipping Wings shall conform to the following random traffic floor tolerances as measured in accordance with ASTM E 1155.
      b. Overall: FF 50, FL 35
      c. Local: FF 35, FL 24
         1) Bound individual floor sections for testing purposes by the following that provide the smallest sections: construction joints, column and half-column lines.
      d. Start testing sections as soon as possible as they become available after slab finishing operations, so as not to impede the slab curing process.
      e. Additional Requirements:
         1) Conform to F-numbers specified for floor areas within 2 feet of construction and isolation joints, in lieu of ASTM E 1155 requirements excluding these areas.
         2) Limit to 1/4-inch maximum elevation change that may occur within 2 feet of vertical elements (such as columns or walls) that pass through slab surface.
         3) If test data indicates areas within 10% of Minimum Local Value, additional testing shall be performed to identify possible out of tolerance areas.
      f. Remedies for Out-of-Tolerance Work:
         1) Remove and replace slabs-on-ground measuring below the specified minimum local F-numbers, unless approved by Owner. If allowed to stay in place, remedy out-of-tolerance work as required by Owner.
         2) If entire project floor, when completed, fails to meet or exceed the specified overall F-numbers, then remedy entire floor as required by Owner.
      g. Elevation Envelope: Provide top of entire slab-on-ground within ± 3/4 of an inch of finished floor elevation shown on Drawings.
      h. Cost Responsibility: Costs for corrective work and extra testing required by defective work borne by Contractor.
   7. DEFINED TRAFFIC FLOORS (SUPERFLAT FLOOR SLAB):
      a. Criteria:
         1) The slab on grade designated as Superflat shall be classified as a defined traffic floor.
         2) Local Flatness/Levelness Tolerances: At all locations in way of the future lift truck wheel tracks - over the vehicle wheel space dimensions - the Defined Traffic Floor shall conform to a Face Floor Profile Number of not less than Fmin-100.
         3) Overall Grade Tolerance: All points on the Defined Traffic Floor shall fall within ± 3/4 inch of the finished floor elevation indicated on the plans.
         4) Floor Tolerance Measurements:
            (a) The Fmin-100 wheel track tolerance shall be tested by the Owner using a continuous recording differential profileograph configured to simulate the future lift truck traffic. A 12 inch longitudinal differential measurement may be used in lieu of the wheelbase simulation to evaluate the "down-aisle" condition of the floor.

(b) The overall grade tolerance shall be tested by conventional rod-and-level survey using an optical or laser level. The survey grid spacing shall not exceed two feet, and no grid point shall fall within two feet of any construction joint.

5) Timeliness of Floor Profile Tests and Interim Reports: On each newly installed Defined Traffic Floor Slab, profileograph testing of the local wheel track tolerance shall commence within 16 hours after completion of the final troweling operation. Within 24 hours after slab installation, the Contractor and Architect will be given a written statement of acceptance or rejection of the new slab. Within 48 hours after installation, each Defined Traffic Floor Slab will be marked by the Owner to show all defective areas requiring repair. (Weekends and holidays shall be ignored when computing the testing and reporting deadlines specified in this paragraph). If inspected, the overall grade tolerance shall be measured within 3 calendar days after slab installation, and results shall be presented to the Contractor not more than 7 days after data collection.

6) Remedy for Out-of-Tolerance Work: Flatness/levelness defects in the Defined Traffic Floor shall be corrected only by grinding or by removal and replacement of the defective slabs. Under no circumstances will filling of low spots be permitted. All areas requiring corrective work will be identified by the Owner, and all corrected areas must be re-measured by profileograph for final approval. All costs for corrective work will be borne exclusively by the Contractor.

8. Anchor Bolt and Other Embedment Placements:
   a. 1/8 inch center to center of any 2 anchor bolts or other embedments within group.
   b. 1/4 inch center to center of adjacent groups.
   c. 1/4 inch within specified elevation.
9. Slab on Ground Dowels:
   a. 0.075 inch maximum in dowel straightness.
   b. Plus or minus 1/8 inch in dowel alignment in vertical and horizontal planes.

1.6 MOCK-UP TEST SLAB

A. Construct mock-up area under conditions similar to those that will exist during actual placement, minimum 20 feet long by 20 feet wide, with coatings applied.

B. Locate where directed.

C. Mock-up may not remain as part of the Work.

1.7 ENVIRONMENTAL CONDITIONS

A. Concreting in Hot, Dry and/or Windy Weather:
   1. Employ methods to avoid cracking when the concrete rate of evaporation exceeds 0.2 pounds per square foot per hour or when any combination of concrete materials and weather conditions are favorable for the formation of plastic shrinkage cracks.
   2. Maintain an accurate thermometer at the job site to check temperature of concrete
   3. Unless otherwise allowed, reject concrete if its temperature before placement is over 90°F.
   4. Unless otherwise allowed, during hot weather mixing and delivery (discharge) time to be shorter than specified in ASTM C 94 as follows:
      a. When air temperature is between 85°F and 90°F, reduce allowable mixing and delivery time from 90 minutes to 75 minutes.
      b. When air temperature is over 90°F, reduce allowable mixing and delivery time to 60 minutes.
   5. Do not place concrete when forms, subgrade, base, or reinforcing bars are more than 120°F or more than 10°F hotter than ambient air temperature.
   6. Cool with water or water-soaked burlap as necessary, but allow no standing water on

surface on which concrete is placed.

B. Concreting in Cold Weather:
   1. Conform to ACI 306.1 when temperature and other environmental conditions are as noted therein and following additional requirements:
      a. Frost susceptible soil shall be replaced with non-frost susceptible soil below the slabs to the depth determined by the Geotechnical Engineer.
      b. Frozen base and subgrade soils shall be thawed immediately before placing concrete.
   2. Do not place slabs on subgrade, or base that are more than 20°F cooler than concrete. Warm subgrade, or base to decrease temperature differential to 20°F or less.

C. Precipitation Protection: Protect surfaces of exposed concrete from precipitation until adequate strength is gained to prevent damage.

1.8 PROJECT CONDITIONS

A. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
   1. No motorized vehicles will be allowed on slabs without proper protection for wheels and oil or hydraulic reservoirs to eliminate oil drips and avoid staining of the concrete.
   2. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
   3. No pipe cutting machine will be used on the inside floor slab.
   4. Steel will not be placed on interior slabs to avoid rust staining.

PART 2 PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 03 1000.

2.2 REINFORCEMENT

A. Comply with requirements of Section 03 2000.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I, II Portland type.

B. Normal Weight Aggregate: Fine and coarse aggregate meeting ASTM C33 except as modified herein.
   1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
   2. Do not use manufactured sand for slabs unless blended with natural sand or otherwise allowed.
   3. For slab-on-grade design mix, conform to the following:
      a. Gradation requirement of ASTM C33 shall be waived in order to meet ranges specified. The conformance with the combined aggregate gradation requirements is of higher priority than meeting ASTM C33 aggregate gradation tolerances alone.
      b. Nominal maximum size coarse aggregate required in mix design shall be 1-1/2 inch (#467 stone).
      c. Adjust proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution characteristics, unless otherwise approved:
         1) Coarseness Factor of 60 to 75%.
            (a) The Coarseness Factor (CF) is the percent of combined aggregate retained on the #8 sieve that is also retained on the 3/8" sieve.
            (b) The Coarseness Factor is calculated as follows: CF = Aggregate retained

on 3/8" sieve / Aggregate retained on #8 sieve.

2) Adjusted Workability Factor:
   (a) The Workability Factor (WF) is the percent of combined aggregate that passes the #8 sieve.
   (b) The Adjusted Workability Factor (Adj-WF) is calculated as follows: Adj-WF = WF + [(Cementitious Material - 564 lbs) / 37.6].
   (c) The range of accepted Adj-WF for a given CF is as follows: Adj-WF = [(11.25 - .15 CF) + 35] +/- 2.5.

d. Of total combined coarse and fine aggregates per mix design, do not allow material retained on any one sieve to be less than 6% nor more than 24% of total by weight, except for largest sieve and No. 100 sieves.
e. Maintain percent of total combined aggregates retained on largest sieve at 1% to 4%.
f. Maintain percent of total combined aggregates retained on No. 100 sieve at 1.5% to 5%.
g. For actual field samples ensure total combined aggregates conform to limits specified herein.
h. Accepted deviations from the above combined gradation are as follows:
   1) Never shall three (3) adjacent sieve sizes fall below 6% retained.
   2) Never shall two (2) adjacent sieve sizes fall below 5% retained.

C. Aggregate used for slab-on-grade mix shall have proven shrinkage characteristics of less than 0.04% in accordance with ASTM C 157 as modified herein.
1. Document slump, air, and temperature of the mixture at the time of mixing - attempt to simulate field conditions.
2. The test mix should include any/all admixtures anticipated at the dosage anticipated. If multiple dosages are possible, test mixes including each potential dosage or test mixtures including the high and low range of the potential dosage. Three beams are required for each mixture.
3. The test beams should be 4 in. x 4 in. x 11¼ in. as 1½ in. aggregate is included in the mix - Section 7.2 of ASTM C-157. Record consolidation procedure.
4. In lieu of the specified 28-day soak in lime-saturated water bath, moist-cure beams in moist room maintained at 100% RH for a period of 7 days. Other than this modification, follow the procedure in Section 10.2 to record the initial comparator reading.
5. After curing, store beams dry (50% RH and 73 °F as specified in Section 11.1.2 of ASTM C-157) and record length measurements using the same comparator used for the initial reading at 3, 7, 14, 21, and 28 days. Document each sample length measurement as well as its initial measurement.
6. Continue storage of samples and record additional verification length measurements at 8, 16, 32, and 64 weeks in accordance with Section 11.1.2 of ASTM C-157.
7. At each test age, report results in accordance with Section 13 of ASTM C-157. Report should include mixture proportions, data for each sample, and ambient conditions of storage room during drying period.

D. Fly Ash: Not permitted.

E. Slag: Not permitted.

F. Water: Clean and not detrimental to concrete.

2.4 CHEMICAL ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C260.

C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
1. Products: Equal to Glenium 7500 by BASF.

D. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

F. Accelerating Admixture: ASTM C494/C494M Type C.

G. Retarding Admixture: ASTM C494/C494M Type B.

H. Water Reducing Admixture: ASTM C494/C494M Type A.

2.5 CRACK REPAIR MATERIAL:

A. Cracks Greater Than 1/8 Inch and less than 3/4 inch: Semi-rigid epoxy joint filler.

B. Cracks Less Than 1/8 Inch: Structural polymer adhesive.
   1. Acceptable Product:
      a. Metzger McGuire: Rapid Refloor.
      b. Roadware, INc.: Roadware 10 Minute Concrete Mender.
   2. Select product color from manufacturers full range to closely match concrete color.

2.6 SPALL REPAIR MATERIAL:

A. Spalls Greater Than 4 inch (in any one direction): Epoxy mortar.
   1. Acceptable Product:
      a. Metzger McGuire: Armor Hard
      b. SpecChem: SpecPoxy Mortar (3-component epoxy mortar; aggregate included)
   2. Physical properties before mixing with aggregate:
      a. Shore D Hardness: 75 (+/- 5)
      b. Compressive Strength: 10,500 PSI
      c. Tensile Strength: 1,400 PSI

B. Spalls Less Than 4 inches (in both directions): Structural polymer adhesive.
   1. Acceptable Product:
      a. Metzger McGuire: Rapid Refloor
   2. Physical Properties:
      a. Shore D Hardness: 70 (+/- 5)2
      b. Compressive Strength: 4,000 PSI
      c. Tensile Strength: 5,500 PSI
      d. Color: select color from manufacturers full range to closely match concrete color.

C. Sand Aggregate for Crack, Spall, and Joint Repair: Use fine, oven-dried, washed silica sand ranging from 20 to 40. Color of sand when added to repair material shall closely match concrete floor color.

2.7 BONDING AND JOINTING PRODUCTS

A. Bonding Admixture:
   1. Type: latex, non-rewettable type
   2. Acceptable Admixture.
      a. Dayton Superior: Acrylic Bonding Agent J40.
      b. Euclid Chemical Co.: SBR Latex or Flex-con
      c. Thoro (Degussa Building Products): Thorobond

B. Bonding Compound
   1. Type: polyvinyl acetate, re-wettable. For interior use only in areas not subject to moisture.
   2. Acceptable Compounds.
      a. Dayton Superior: PVA Bonding Agent J41
      b. Euclid Chemical Co.: Euco Weld

C. Epoxy Adhesive
   1. Type: two (2) component, 100% solids, and 100% reactive compound suitable for use

on dry or damp surfaces.
2. Acceptable Adhesive.
   a. Dayton Superior: Sure Bond J58
   b. Euclid Chemical Co.: Euco Epoxy #452 or #620
   c. Sika Chemical Corp.: Sikadur 32 Hi-Mod

D. Polymer Repair Mortar:
1. Type: Polymer and microsilica modified cementitious-based compounds.
2. Acceptable Mortar (horizontal).
   a. Dayton Superior: Thin Resurfacer
   b. Euclid Chemical Co.: Thin Top Supreme or Concrete Top Supreme
   c. Sika Chemical Corp.: Sikatop 121 Plus or 122 Plus
3. Acceptable Mortars: (vertical)
   a. Dayton Superior: Civil/ Structural VO.
   b. Euclid Chemical Co.: Verticoat/Verticoat Supreme
   c. Sika Chemical Corp.: Sikatop Plus 123

E. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.
2. Products:
   a. W.R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.8 EVAPORATION RETARDER

A. Evaporation Retarder: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
1. Products:
   a. Dayton Superior: AquaFilm.
   b. Euclid: Eucobar.
   c. L & M: E-Con
   d. Nox-Crete: Monofilm
   e. Sonneborn: Confilm
   f. SpecChem: Spec Film

2.9 CURING MATERIALS

A. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound, that dissipates within 3 to 5 weeks; complying with ASTM C309 Type 1 - Clear or translucent, Class B. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal. VOC compliant..
1. Product shall be compatible with tilt-up bond breaker, floor hardeners, sealers, and floor coverings.
2. Product shall be easily removeable from slab surface if film forming, and if used under building cover and not exposed to UV light.

B. Water: Potable, not detrimental to concrete.

2.10 MIXING DESIGNS:

A. Design mixes to provide normal weight concrete with the following properties:
1. Footings:
   a. 28-Day Strength: 3,000 psi minimum.
   b. Slump Range: 4 inch +/- 1 inch.
   c. Admixtures: None required.
2. Interior Slab-on-Grade:
   a. 28-Day Strength: 4,000 psi minimum.

b. Top Size Aggregate Included: 1 1/2 inches.
c. Max. W/C Ratio: 0.52.
d. Slump Range: 4.5 inch +/- 1 inch. Concrete with a slump as measured per ASTM C143 exceeding 5.5 inches at the point of deposit on the sub-base shall be rejected.
e. Admixtures:
   1) Water-reducing, 6 oz./100 lbs. cement max.
   2) Accelerating permissible when ambient air temperature less than 40 degrees F, quantity as approved by Engineer.
f. Time of Setting: Initial setting time shall not exceed 400 minutes as determined by ASTM C 403 for a laboratory sample representing the submitted mix design, admixture dosages, and concrete temperature of 60 degrees F +/- 5 degrees F. Only one specimen or time of setting test is required per sample. If more than one test is performed per sample, report average times of initial setting. Test shall be performed by an independent testing agency selected by, and as a responsibility of, the Concrete Supplier.

3. Superflat Slab-on-Grade: See structural drawings for special requirements.
4. Tilt-up Wall Panels:
   a. 28-Day Strength: 4,000 psi minimum.
   b. Max. Aggregate Size: 1 inch for tilt-up panels.
   c. Max. W/C Ratio: 0.52.
   d. Slump Range: 5 inch +/- 1 inch.
   e. Admixtures:
      1) Water-reducing, 6 oz./100 lbs. cement max.
      2) Accelerating permissible when ambient air temperature less than 40 degrees F, quantity as approved by Engineer.
5. Non-structural and Miscellaneous Constructions (sidewalks):
   a. 28-Day Strength: 3,000 psi.
   b. Slump Range: 4 inch +/- 1 inch.
   c. Admixtures:
      1) Air entraining, 6% maximum, for exterior concrete.

B. 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.

PART 3 EXECUTION

3.1 INSPECTION:

A. Pre-slab Meeting: A minimum of 14 days prior to beginning concrete placement, Contractor shall schedule meeting, as described in Section 01 3000 - Administrative Requirements, with Owner's Representative, Architect, Testing Agency, Concrete supplier, admixture manufacturer, Concrete placing and finishing foreman and other affected subcontractors. Discuss mix designs, placing procedures, acceptability of formwork and reinforcement, acceptable tolerances and finishes, testing, curing and protection. Contractor shall be responsible for keeping minutes of meeting and distributing to attending parties.

3.2 BATCHING AND MIXING:

A. Batch, mix and transport in accord with ASTM C94, except where more stringent requirements are specified.

B. Delivery Tickets: Concrete producer shall furnish with each load of concrete a numbered delivery ticket showing Contractor, name and location of project, date and time batched,

truck number, number of cubic yards in load, specified strength, slump and mix design number.

1. Slab-on-Grade Mix: All delivery tickets shall be clearly marked to also show in gallons per cubic yard:
   a. The “maximum permitted water content”.
   b. The “actual batch water content” (including the water estimated to have been introduced by the aggregate).
   c. The “maximum permitted additional water for slump adjustment” (ie. the difference between the “maximum” and “actual” water contents).

C. Clean truck mixer drums prior to each batching of concrete. Load truck mixers at capacity that will ensure uniform batch at slump specified. Reject non-uniform mixing.

D. Start mixing time after all ingredients are in mixer. Minimum mixing shall be 70 revolutions at mixing speed, if charged to maximum capacity; 50 revolutions at mixing speed, if charged to less than maximum capacity.

E. When concrete is delivered in a truck mixer or agitator, no additional water shall be added after the initial introduction of mixing water for the batch, except when on arrival at project site the slump of the concrete is less than that specified or as allowed herein for hot weather concreting. Such additional water (not to exceed the required water/cement ratio) may be added to bring slump within required limits, and shall be injected into the mixer. The drum or blades shall be turned an additional 30 revolutions or more at mixing speed until the concrete is within the proper slump limits.

F. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

G. Concrete shall be delivered at such a rate as will assure prompt discharge upon truck arrival. Place no concrete that has been discharged from mixer truck for longer than 30 minutes.

H. Reject truck mixers with unacceptable batches of concrete. Dispose of concrete legally and clean mixer prior to refill. Rejected mixers shall be tested by Testing Agency on new delivery for slump and mix tests.

I. Cause for rejection of concrete:
   1. Concrete exceeds allowable slump.
   2. Excessive air (over 3%) in concrete for floor slabs, and in other instances where air exceeds project specifications.
   3. Concrete temperature at placement exceeds 90 degrees F.
   4. Concrete discharge exceeds 90 minute time limit and in other instances where concrete does not meet project specifications.

3.3 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.4 PREPARATION

A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

B. Install premolded expansion-contraction joint filler in accordance with manufacturer's instructions.
   1. Position joint filler against forms, at interrupting objects or columns, and against abutting structures before concrete placement.
   2. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Place expansion joint cap to flush with finished slab surface.
   3. Prior to installation of joint sealant, slide expansion joint cap off the expansion joint.

4. Conform to Section 07 9005 for joint sealer requirements.

3.5 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. All footing excavations should be examined by the Geotechnical Engineer to verify that the design bearing pressure is available. All footings should be clean, level and free of ponding water. Since the soils tend to soften upon exposure, concrete should be placed as soon as is practical after the footing is excavated. Any open footing shall be protected from weather conditions until reinforcing steel and concrete can be placed.

F. Slab on grade shall be placed on compacted subbase. Fine grade subbase using a laser controlled grading box and then roller compact to within ± 3/8” of final grade. A final examination of the subbase shall be performed by the Geotechnical Engineer immediately prior to placing floor slabs. If the exposed subgrade becomes wet or frozen, the surface shall be recompacted at the direction of the Geotechnical Engineer. The minimum compaction required unless noted otherwise is 98% of ASTM Specification D-698 (Standard Proctor Density). Proof roll each slab placement area on the day prior to slab installation using a loaded 40 GWT tandem axle truck. Slabs shall not be placed over any base that visibly “pumps” or ruts more than ½ inch under such proof rolling. If pumping is encountered, Contractor shall make repairs as recommended by the Geotechnical Engineer at no additional cost to the Owner or extension of Contract Time.

G. Before placing concrete, inspect and approve formwork, reinforcement, sleeves and embedded items.

H. Maintain reinforcing in proper position on dobies during concrete placement. Use sufficient dobies to withstand construction loads. Hold reinforcing in place not less than one support per 15 sf of slab area.

I. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

J. Handle concrete from mixer to place of final deposit as rapidly as practical by methods that shall prevent segregation or loss of ingredients. Distribute concrete by means of equal to a steep sided bottom drop concrete bucket. Allow no concrete to free-fall over 4'-0". Utilize buckets with a capacity of not less than 1/2 cu. yd. Clean transporting and handling equipment at frequent intervals and flush with water before and after each day's run. Discharge no water into concrete forms.

K. Place no concrete in forms after initial set has taken. Re-tempering of concrete that has partially set is prohibited. Place no concrete while temperature or other environmental conditions or limitations of facilities prevent proper finishing and curing.

L. Deposit concrete as near final position as possible to avoid rehandling. Place concrete in forms with uniform horizontal layers 1'-6" to 2'-0" in depth; avoid vertical joints or inclined planes. Do not permit piling up of concrete in forms in a manner to permit escape of mortar or flow of the concrete. Deposit concrete continuously with thorough consolidation by vibrating to insure a dense, homogeneous mass without voids or pockets.

M. Transport and place pumped concrete in accord with ACI 304 requirements. Brace formwork to handle effects of pump hammer. Employ aggregates of controlled water contents for pumped concrete. Use no aluminum pipes for transporting concrete. Equipment used to transport concrete shall be compatible with concrete reinforcement and desired finishes.

N. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.6 CONSOLIDATION:

A. Use vibrators for concrete consolidation. Place vibrators in concrete rapidly to penetrate into previous lift blending two layers and minimizing or eliminating entrapped air between concrete and form.

B. Use vibrators along slab-on-grade edge forms to properly consolidate concrete around construction joint reinforcement dowels. Vibrator head shall not be allowed to come within 3" of form face.

C. Use vibrators with steady, continuous motion in concrete mass and for long enough duration at each position in a pattern to permit maximum escape of air from concrete.

D. Vibrators shall be 2-1/2" to 2-5/8" in diameter with minimum frequency of 10,000 impulses per minute. Furnish number of vibrators as required to vibrate all concrete immediately upon placing. Maintain spare vibrators at project site in case of breakdown. Use and type of vibrators shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".

3.7 COLD WEATHER CONCRETING:

A. Take cold weather precautions when temperature on job site is below 40 degrees F., in accord with ACI 306R. Accelerators, if used, shall be added at the concrete producer's plant in accord with approved mix design.

B. Heat water, aggregates or both to maintain the temperature of the concrete at the time of delivery at not less than 55 degrees F. Provide tarps, heaters, insulated forms or other means to maintain the temperature of deposited concrete at not less than 40 degrees F. for seven days after placement.

3.8 HOT WEATHER CONCRETING:

A. Concreting in Hot, Dry and/or Windy Weather:
   1. Conform to ACI 305R when any combination of high air or concrete temperature, low relative humidity, and wind velocity tend to impair quality of concrete.
   2. Employ special precautions when evaporation rate as obtained from ACI 305R is expected to reach 0.2 pound per square foot per hour or more.
   3. Unless otherwise allowed, reject concrete if its temperature before placement is over 90F.
   4. Unless otherwise allowed, during hot weather mixing and delivery (discharge) time shall be shorter than specified in ASTM C94 as follows:
      a. When air temperature is between 85F and 90F, reduce allowable mixing and delivery time from 90 minutes to 75 minutes.
      b. When air temperature is greater than 90F, reduce allowable mixing and delivery time to 60 minutes.
   5. Do not place concrete when forms, subgrade, base, or reinforcing bars are more than 120F or more than 10F hotter than ambient air temperature.
   6. Cool with water or water-soaked burlap as necessary, but allow no standing water on surface on which concrete is placed.

B. Retarders, if used, shall be added at concrete producer's plant in accord with approved mix designs. Where necessary, cool aggregates or use chilled water or both to maintain concrete temperature as delivered to the job site below 90 degrees F.

C. In hot weather, up to 10% of design mix water (not to exceed the required water/cement

ratio) may be added to truck mixers at job site to replace water lost by evaporation. Mix for minimum of 30 additional revolutions after water is added. Make slump test and cylinders for compression test specimens from each truck to which water has been added. The additional cylinders shall not be counted in determining "frequency of testing" as defined in Concrete Testing section. Cost for additional testing shall be borne by Contractor.

3.9 SLAB FINISHES:

A. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

B. Using Laser Screed, consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners. Do not over-vibrate surface.

C. Bring slab surfaces to correct level with straightedge and strike-off. Use highway straightedge, bull float or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

D. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Float surfaces on concrete in manner that will compact concrete and produce surface free of depressions or ridges. Test for grade or level and correct as necessary by removing excess or adding and compacting additional concrete. Surfaces to receive float finish include slabs to receive setting beds.

E. Check and level surface plane to tolerance of 1/4" maximum deviation in 10 feet. Cut down high spots and fill low spots.

F. Trowel finish: Apply a 3 trowel finish to designated monolithic slab surfaces. After floating, begin first trowel finish operation using power-driven trowel. Begin final toweling when surface produces ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand and power troweling operation, free of trowel marks, uniform in texture and appearance. Do not overwork the final troweling operation. Do NOT burnish the slab surface.

G. Non-slip broom finish: Immediately after trowel finishing, roughen concrete surface by brooming in direction perpendicular to main traffic routes. Coordinate required final finish with Architect before application. Apply non-slip broom finish to all exterior concrete platforms, steps, pavement and ramps.

3.10 SLAB JOINTING

A. Locate joints as indicated on the drawings.

B. Construction Joints:
   1. Locate construction joints as indicated on the drawings or as approved.
   2. Provide 1/8 inch edger to edge of second slab placement so that joint can be easily located and recut for joint filling operation. Do not edge first placement.

C. Sawcut Contraction Joints:
   1. All sawn contraction joints shall be made using the "Soff-Cut" method. Minimum depth of joint with new blade shall be 1-1/2 inch.
   2. Saw joints immediately following the final finishing operation in accordance with recommendations of Soff-Cut International, and as soon as concrete has hardened sufficiently to prevent raveling or dislodging of aggregates. For "Soff-Cut" saw, this will typically be from 1 hour in hot weather to 4 hours in cold weather after completing finishing of slab in that joint location.
   3. Install Velcro or other non-scratch material to base of skid plate to reduce surface scratching.
   4. Replace saw blades at first sign of raveling at the joint. Guide plate shall be replaced each time a saw blade is replaced.

5. Use "joint saver" inserts, provided by the saw manufacturer, at all intersecting joints and at location where front wheel crosses perpendicular to the previously cut joint.
6. Use offset grinder with abrasive wheel or small diameter diamond blade to extend saw cut into column or perimeter isolation joint material.

D. Saw-Cut Control Joint Dust Collection
1. Connect a dust collection system directly to each Soff-Cut saw being used.
2. Remove all saw debris, either loose or compacted, from slab surface and joints prior to curing cover installation.

E. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.

3.11 CONCRETE FORM FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

3.12 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
1. Normal concrete: Not less than 7 days.
2. High early strength concrete: Not less than 4 days.

C. Membrane Curing Compound:
1. The compound shall be applied uniformly over the entire surface in accordance with manufacturer's instruction.
2. Moisture loss from absorption of forms shall be minimized by keeping forms wet until they can be safely removed.
3. During 7 day curing period, the surfaces shall be protected from damage by equipment, temperature change, stored materials, curing procedures, rain and running water.

3.13 GRINDING OF CONSTRUCTION JOINTS

A. All construction joints shall be ground and polished to an even, smooth, slick finish using gasoline powered diamond-disk and/or stone grinders. The final polishing pass shall be performed using not less than 100 grit stone.

3.14 PROTECTION:

A. Where other concrete structures are to be poured on top of or adjacent to finished surfaces, take all necessary precautions to prevent damage from erection of formwork or staining from concrete laitance.

B. Alert other trades to the need for special protection against rolling or sliding heavy loads across the surface, oil drippings from pipe threaders, spillage of paint, plaster and mortar. Insure that the covering is not damaged or removed during the progress of the work.

C. Review proposed tilt panel construction and erection procedures to ensure that scratching,

marring, gouging, and cracking of the floor slabs will be avoided.

3.15 DEFECTIVE FLOOR SLAB:

A. Defective Slab: If it is determined that any type of crack or defect in the slab-on-ground has occurred due to the result of Contractor's failure to comply with these specifications and construction documents, Contractor shall repair and/or replace cracked and defective slabs to the satisfaction of the Owner, and as directed by the Architect.

3.16 CRACK AND SPALL REPAIR OF FLOOR SLABS:

A. Coordination: Repairs made after the Owner moves in shall be made at times that do not interfere with regular business activities.

B. Repair those cracks that meet any of the following conditions:
   1. The crack is within the "shipping/receiving" bays.
   2. The crack is wider than 1/ 32 inch (i.e. “credit card width”).
   3. The crack edges have begun to spall.
   4. Adjacent slab elements (on either side of the crack) exhibit vertical movement when crossed by a loaded forklift.

C. Method of Crack Repair: Follow these steps (or use other method acceptable to the Architect):
   1. Multiple cracks clustered in a spider web appearance, or cracks within the "shipping/receiving" bays:
      a. Remove concrete slab forming a rectangular area normal to column grid. Extend rectangular area to the nearest control or construction joint.
      b. Place and finish new concrete with same specifications as original slab. All edges shall be doweled into existing slab using 3/4 x 12 inch long square steel dowels at 18 inches on-center. Dowels shall be placed centered in slab. Drill oversized 1-1/4" holes approximately 5-1/4" deep in to the existing slab to receive square dowels, set in epoxy grout. Install PNA square dowel clips over dowel length to be placed in new slab.
   2. Isolated random cracks less than 1/8 inch wide, without "islands" or chipping, and not subject to movement:
      a. Clean crack out using right angle grinder with soft wire wheel or wire brush, then blow out with air.
      b. Following manufacturer's mixing and installation instructions fill the crack with structural polymer adhesive material slightly overfilling. Monitor top and refill if necessary to assure fill remains crowned above floor surface.
      c. After cure, use medium grit grinding pad to remove excess material flush with floor surface.
   3. Isolated random cracks greater than 1/8 inch and less than 3/4 inch, and not subject to movement:
      a. Utilizing crack chasing saws and dust-free cleanout, cut along the crack to a depth of approximately 3/4 inch creating a straight, clean vertical edge. Ensure that all concrete “islands”, and any loose or weak concrete from the crack edge is removed. Blow out with air to clear all loose elements or debris.
      b. Following manufacturer's mixing and installation instructions fill the joint with semi-rigid epoxy joint filler. Monitor top and refill if necessary to assure fill remains crowned above floor surface
      c. After cure, trim the overfill using a stiff sharp razor so top of filler material is flush with concrete floor on both sides.

D. Method of Spall Repair: Follow these steps (or use other method acceptable to the Architect):
   1. Bolt holes, small gouges, chips, and spall areas less than 4 inches:
      a. For anchor bolt holes, cut bolt off and drive anchor minimum 1/2" below floor surface.

b. Roughen surface of concrete with grinder. Sweep and vacuum roughened surface to remove debris.
c. Clean surfaces free of oil, grease, coatings, sealers, paint, rust, etc. Verify surfaces are dry, and structurally sound.
d. Following manufacturer's mixing and installation instructions fill area with structural polymer adhesive, slightly overfilling, and trowel smooth.
e. After material has cured, grind off overfill to ensure flush, smooth floor surfaces.

2. Spalled areas 4 inches and greater:
a. Prevent feather edging by making vertical cuts at the spall outer edges, minimum 3/4 inch deep.
b. Remove delaminated material and deteriorated concrete surface material a minimum depth of 1/2 inch. Sweep and vacuum roughened surface to remove debris.
c. Clean surfaces free of oil, grease, coatings, sealers, paint, rust, etc. Verify surfaces are dry, and structurally sound.
d. Following manufacturer's mixing and installation instructions fill area with epoxy mortar repair material, slightly overfilling, and trowel smooth.
e. After material has cured, grind off overfill to ensure flush, smooth floor surfaces.

3.17 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Testing Agency Duties:
1. Review proposed mix designs for concrete classes specified.
2. Review concrete materials for compliance with specifications. Obtain samples as required.
3. Concrete Plant Certification: Certify plants proposed for furnishing concrete as being approved at highest level by NRMCA or by Department of Transportation in state where project is located.
4. Sample concrete at project site and prepare compressive strength test specimens, tests for slump, air content and unit weight.
5. Maintain field test data sheet for each set of concrete specimens. The completed data sheet shall include laboratory number, date, plant, truck number, time batched, time sampled, air temperature, concrete temperature, inspector, mix design number, required compressive strength, unit weight, air content, slump, location of placement, seven day and 28 day strengths.
6. Transport test specimens to Testing Agency's laboratory.
7. Perform specified laboratory tests.
8. Notify Architect immediately of any test specimens that do not meet design compressive strength at 28 days or 2/3 of design strength at seven days.
9. Perform floor tolerance measurements.

E. Contractor Duties Regarding Testing Agency:
1. Provide a space suitable for Testing Agency to store 1-6 day old cylinders that will not require continual movement during construction.
2. If weather dictates, provide for Testing Agency an on site curing space in accordance with ACI standards for storage of cylinders during cold weather concreting.

F. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
1. Specimens may be 4x8 inch cylinders or 6x12 inch cylinders.

2. When the frequency of testing will provide less than five acceptance tests for a given mix design, tests shall be made from at least five batches selected at random or from each batch.
3. Perform acceptance testing using cylinders at 28 days.
4. Compressive strength of concrete will be considered satisfactory if averages of all sets of three consecutive strength test results equal or exceed the required 28 day design compressive strength and no individual strength test result falls below design compressive strength by more than 500 psi.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

H. For trowel finished slabs, perform air test for every 100 cu yd or less of concrete placed. Reject concrete if air content is over 3%.

I. During first day of concrete placement and later as directed by Owner's Representative, take concrete sample at point of final placement to verify mix design submittals. Washout sample to remove material finer than No. 200 sieve and perform combined sieve analysis, using sieve sizes specified, furnishing percent retained on each sieve. Ensure concrete sample size is large enough to be representative but is not less than 70 pounds. Conform to ASTM C136. As compared to approved concrete mix design, of total combined coarse and fine aggregates, ensure within tolerance for material retained on any 1 sieve of 3% and +4%, except No. 100 sieve. Ensure within tolerance for material retained on No. 100 sieve is +2% or 2%.

3.18 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

END OF SECTION

SECTION 03 3511

CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

PART 2 PRODUCTS

2.1 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
   1. Composition: Lithium silicate.
   2. Penetrating, chemically reactive, concrete hardener containing a minimum 7% lithium silicate solids, (no potassium or sodium silicate blends allowed) equal to:
      a. Dayton Superior: Pentra-Hard Densifier
      b. Nox-Crete: Duro-Nox LSC
      c. Prosoco: Consolideck LS-CS
      d. SpecChem: LithSeal SC

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

C. Examine slab surface prior to starting work, with liquid surface treatment Applicator present, for conditions affecting the Applicator's ability to properly apply the liquid surface treatment. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

D. Verify via water test or other non-destructive test that no bond breakers, curing compounds or similar materials are present. If such materials are present; do not proceed until they are removed.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.3 PENETRATING CONCRETE HARDENER:

A. Immediately prior to Substantial Completion, apply hardener to all areas scheduled to receive sealer/hardener.

B. Application: Follow the manufacturer's written instructions for the application of the hardener.
   1. The manufacturer’s technical representative shall be present at the initial application to observe the work and provide technical assistance.
   2. It is critical that the slab be clean and all surface dirt and curing membrane residue be completely removed prior to application.

C. Cleaning and Floor Preparation:
   1. Power sweep floor area and blow out corners and adjacent columns. Use sweeping compound to control airborne dust.
   2. If oil spots, rust stains, paint droppings, tire marks and other surface stains are present in spite of specified precautions, remove and replace affected slab panels unless Owner's Representative accepts treated and cleaned areas. If allowed, treat oil spots with oil emulsifier, and oil absorber materials or other acceptable means and materials. If allowed, remove paint droppings with soft, damp cloth and solvent stripper. Do not use stripper with an acidic pH.
   3. Double scrub floor with automatic scrubber with appropriate soft brushes or pads and specified floor cleaner to remove all latent salts and other residue.
   4. Power rinse surface removing traces of any remaining residue.

D. Sealer and Hardener Treatment Application:
   1. Immediately following cleaning operation and surface is dry, use low pressure sprayer, airless sprayer, or other approved mechanism, to apply sealer and hardener treatment material in accordance with manufacturer's published instructions and approved submittal. Evenly distribute and back-wipe sealer and hardener treatment material using micro-fine pad to remove puddles and even lap marks.

END OF SECTION

SECTION 03 4100

ALTERNATE - PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulated concrete wall panels.

B. Grout packing.

C. Connection and supporting devices.

1.2 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

E. ASTM A416/A416M - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2012a.

F. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.

G. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.

J. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011.

K. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; Precast/Prestressed Concrete Institute; 1999, Fourth Edition.

L. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete; Precast/Prestressed Concrete Institute; 1988, Second Edition.

M. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; Precast/Prestressed Concrete Institute; 2000.

1.3 DESIGN REQUIREMENTS

A. Conform to ACI 318 and applicable code for design load and construction requirements applicable to work of this section.

B. Design components to withstand dead loads and design loads in the configuration indicated on the drawings.
   1. Maximum Allowable Deflection of Wall Panel: 1/240 span.
   2. Calculate structural properties of framing members in accordance with ACI 318.

C. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.

D. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

E. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.

F. Minimum construction period wind force of 15 psf for temporary bracing.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, design loads and assumptions, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

C. Indicate locations and details of temporary bracing and supports including: construction period design wind speed; total brace force per panel; brace type, locations, and number of braces required; deadman or soil anchor type, size, location, and number required; and post-installed anchor type and torque required.

D. Design Data: Submit design data reports signed and sealed by the responsible, qualified Professional Engineer licensed in the State in which the Project is located. Indicate calculations for loadings and stresses of fabricated, designed framing, and temporary bracing including connections to deadman, slab on grade, or soil anchor.

1.5 QUALITY ASSURANCE

A. Perform work of this section in accordance with requirements of PCI MNL-116, PCI MNL-120, PCI MNL-123, and PCI MNL-135.

B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of experience. The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) plant Certification program, the National Precast Concrete Association (NPCA) plant certification program, or other qualified third party certification prior to start of fabrication of this project.

C. Erector Qualifications: Company specializing in erecting products of this section with minimum three years of experience.

D. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

E. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

B. Protect members to prevent staining, chipping, or spalling of concrete.

C. Mark each member with date of production and final position in structure.

1.7 PROJECT CONDITIONS

A. Coordinate the work of framing components not pre-tensioned but associated with the work

of this section.

PART 2 PRODUCTS

2.1 PRECAST UNITS

A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.
   1. Calculate structural properties of framing members in accordance with ACI 318.
   2. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.
   3. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

2.2 MATERIALS

A. Cement: Gray Portland type, conforming to ASTM C150, Type I or III.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.3 REINFORCEMENT

A. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 or 270; seven-wire stranded steel cable; low-relaxation type; full length without splices; uncoated.

B. Reinforcing Steel: ASTM A615/A615M Grade 40 (280).
   1. Deformed billet-steel bars.
   2. Unfinished.

C. Steel Welded Wire Reinforcement: ASTM A185/A185M plain type or ASTM A497/A497M deformed type; in flat sheets; unfinished.

2.4 ACCESSORIES

A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, and inserts conforming to PCI MNL-123, and as follows:
   1. Material: Carbon steel conforming to ASTM A36/A36M.
   2. Finish: Hot-dip galvanized in accordance with ASTM A153/A153M
      a. Prime painted except where indicated otherwise.
      b. Hot-dip galvanized in accordance with ASTM A153 for all devices below steel joist and above floor slab, and exterior locations.

B. Grout:
   1. Non-shrink, non-metallic, minimum yield strength of 4,000 psi at 28 days.

C. Insulation: Type and thickness of insulation as required to provide a composite R-Value of 10.0 (minimum) for panel.

D. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, or Neoprene (Chloroprene); 1/8 inch thick, smooth both sides.

E. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.

F. Prime Paint: Zinc rich alkyd type.

2.5 FABRICATION

A. Conform to fabrication procedures specified in PCI MNL-116.

B. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are

embedded and located as indicated on shop drawings.

C. Tension reinforcement tendons as required to achieve design load criteria.

D. Provide required openings with a dimension larger than 10 inches and embed accessories provided under other sections of the specifications, at indicated locations.

E. Exposed Ends at exposed insulation: Fill recess with non-shrink grout, trowel flush.

2.6 FINISHES

A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. All defects, which are exposed to view, shall be corrected before final finish.

D. Finish members to PCI MNL-116 Finish B grade.
   1. All air holes over 1/4 inch should be filled, as well as smaller holes that occur in concentrations. Discoloration allowed at form joints; form joints ground smooth.
   2. Exterior surfaces not cast on form liners shall have a smooth finish with all fins removed.
   3. Interior surfaces exposed to view shall have smooth screed finish.
   4. Interior surfaces not exposed to view shall have a float finish.

2.7 FABRICATION TOLERANCES

A. Conform to fabrication tolerances specified in PCI MNL-116.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings.

B. Site Access: General contractor shall be responsible for providing suitable access to the building, proper drainage and firm, level bearing for the hauling and erection equipment to operate under their own power.

3.2 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.3 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. After placing, provide temporary braces and supports to securely hold panels in position. Maintain braces and supports in place, undisturbed, until closures, columns, or other supporting structures have been installed and are capable of receiving panels. Use of manufacturer specified or approved brace anchors at all bracing points shall be required. Wedge anchors or expansion bolts by others is not acceptable.
   1. All slab anchors shall be torqued to the required specification and certified by the installing contractor. All slab anchors must be re-torqued and re-certified following exposure to winds in excess of 35 mph.

D. Install bearing pads.

E. Secure units in place. Perform welding in accordance with AWS D1.1.

F. Protect members from staining.

G. Holes caused by installation of temporary braces anchored to floor slabs shall be patched with structural polymer adhesive, flush and smooth with floor surface. Color shall closely match concrete color. Provide mockup of patch for Architect approval prior to beginning work.

H. Patch panels with grout where lifting hooks or other devices have been removed. Plastic insert covers are not acceptable.

3.4 TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-135 for erection tolerances.

C. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect. Execute modifications as directed.

3.5 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

3.6 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 03 4713

TILT-UP CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tilt-up, site cast concrete wall panels, load bearing, erected from mold to final position.

B. Supports, devices, and attachments.

C. Grouting under panels.

D. The Architect/Engineer has not been retained to design the wall panels or the floor slab to resist the stresses caused by erection of the wall panels, nor to determine the means and methods to be used for erection and bracing until permanent bracing is in place.
   1. It shall be the Contractor's responsibility to erect the panel in a manner that will be both safe for personnel and property, and to brace and otherwise protect the panels against wind and other forces that may occur during construction and until connections to the permanent structural system are completed.
   2. It shall be the Contractor's responsibility to ensure that a suitable slab has been prepared to provide for the level of finish that has been established within this specification.
   3. It shall be the Contractor's responsibility to coordinate the slab finishing including saw cutting of all joints with the panel forming to minimize the impact to the architectural finish of the panels.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-In-Place Concrete: Requirements for concrete for tilt-up panels.

B. Section 03 3511 - Concrete Floor Finishing.

C. Section 05 5000 - Metal Fabrications: Miscellaneous metal for embedment.

D. Section 07 9005 - Joint Sealers: Calking of perimeter joint with sealant and backing.

E. Section 09 9035 - Textured Coatings: Field applied painting of tilt-up panels.

1.3 REFERENCE STANDARDS

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

C. ACI 305R - Hot Weather Concreting; 2010.

D. ACI 306R - Cold Weather Concreting; 2010.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.

G. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.

H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2012.

I. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2010.

K. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' current data on manufactured items used, including recommended methods of installation, relevant installation limitations, and safety precautions. Submit current product data for bondbreakers, grouts and patching materials.

C. Shop Drawings: Indicate layout, tilt-up unit locations, configuration, unit identification marks, reinforcement, connection details, support items, location of lifting devices, dimensions, openings, reveals and relationship to adjacent components.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 318.

B. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 5 years of documented experience.

C. Design units under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
   1. Construction Loads: Design and fabricate tilt-up wall panels to withstand construction loads which may occur during lifting, bracing, and impact by adjoining panels.
   2. Comply with the recommendations of the Tilt-Up Concrete Association’s Guideline for Temporary Wind Bracing of Tilt-Up Concrete Panels During Construction. The minimum construction period wind force shall be 15 psf and adjusted higher based upon the appropriate factors for the project.

D. Welding Qualifications: Welding processes and welding operators qualified within previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.6 FIELD CONDITIONS

A. Cold Weather: Comply with provisions of ACI 306R for freezing or near-freezing conditions.
   1. Provide adequate equipment for heating and protecting concrete materials.
   2. Do not use concrete materials, reinforcing steel, forms, fillers, ground surface, or other materials that are frozen, frost-covered or that contain ice.
   3. If shelters are used, do not use fuel that will weaken concrete surfaces.

B. Hot Weather: Comply with provisions of ACI 305R for high temperature conditions.
   1. During periods of dry winds, low humidity, and other conditions that cause rapid drying, protect fresh concrete with an evaporation retardant or fine fog spray of water applied immediately after screeding and bull floating.
   2. Maintain protection until final finishing and curing compounds are applied.

PART 2 PRODUCTS

2.1 TILT-UP PANEL UNITS

A. Tilt-Up Panel Units:
   1. Concrete: Minimum 4,000 psi, 28 day strength; comply with ACI 301.
   2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by

applicable code.
3. Calculate structural properties of units in accordance with ACI 318.
4. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
5. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.
6. Provide lifting hardware and lifting system appropriate to panel size and configuration.

2.2 PANEL MATERIALS

A. Provide basic concrete materials in accordance with Section 03 3000.

B. Curing Compound: Liquid membrane-forming compound complying with ASTM C309, Type I and ID, Class B.

C. Bond Breaker: Product shall be a non-staining, bond breaker compatible with the curing compound and sealer/hardeners specified in Section 03 3513. Contractor shall assume all responsibility for properly preparing floor slab to receive sealer or sealer/hardeners.
1. Dayton Superior: J-6 WB
2. Richmond: Maxi Tilt with Dye
3. Nox-Crete: Silcoseal 2000CF
4. SpecChem: SpecTilt WB

D. Grout: Beneath panels, provide standard type, sand and cement compound capable of developing over 3,000 psi compressive strength in 28 days.

E. Sacking Materials: Portland cement, polymer modifiers, ultra-fine aggregates and water, mixed to a uniform creamy paste.
1. Dayton Superior: Architectural Finish
2. Nox-Crete: Panel Patch
3. CTS Cements: Rapid Set WunderFixx
4. SpecChem: Spec Smooth

F. Reinforcement:
1. General: Meet ACI 533.1R Chapter 7.
2. Bars: Meet ASTM A615 with Supplement S1, grade 60, except that ties may be grade 40. #3 and larger bars shall be deformed type.
3. Welded wire fabric: Meet ASTM A185, cold-drawn, resistance welded.
4. Tie Wire: 16 gauge annealed steel wire.
5. Bar Supports: Prefabricated accessories shall comply with CRSI Manual of Standard Practice MSP-I-80 as follows:
   a. For exposed, exterior formed work designated to receive smooth formed or rubbed finish: Class 2, stainless steel, type B.
   b. For exposed, exterior formed work designated to receive special architectural finishes: Class 1, plastic protected.
6. Bar mats for concrete reinforcement shall conform to ASTM A184.

G. Forms: Wood material to maintain forms in good alignment and produce required finish.
1. External form bracing shall be equal to Aztec “Tilt Bracket” system with self-adhering plastic shoe and reusable plastic bracket, to prevent form displacement during casting operations.

H. Reveals:
1. Acceptable materials for forming reveals:
   a. Medium density fiberboard.
   b. High density extruded polystyrene foam with minimum 40 psi compressive strength.
2. Spray Adhesive: equal to Demand Products (800-325-7540) "Foam Lock Adhesive", or approved equal.

I. Floor Protection Inserts: PVC inserts equal to "Slab Saver" by Victory Bear Construction

Products.

2.3 LIFTING DEVICES, INSERTS AND BRACES:

A. Acceptable Manufacturer:
   1. Burke.
   2. Dayton Superior.
   3. Richmond Screw Anchor.

B. Wall panel lifting devices, inserts and additional reinforcement required for lifting of the panels shall be designed by the approved manufacturer and certified by a Structural Engineer registered in the state where the project is located.

C. Panel braces shall be designed by the approved manufacturer.
   1. Comply with the recommendations of the Tilt-Up Concrete Association's Guideline for Temporary Wind Bracing of Tilt-Up Concrete Panels During Construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

B. Verify that casting slab specified in Section 03 3000 is cured and ready for work of this section. Fill cracks, saw cuts, joints, or defects that would adversely affect appearance of tilt-up panels.

3.2 PREPARATION

A. Coordinate site cast tilt-up operations with work of other sections to expedite the Work and avoid omissions and delays.

B. Apply bondbreaker to casting slab in accordance with manufacturer's recommendations.

C. Provide for erection procedures and induced loads during erection, and provide for temporary bracing that will remain in place until roof diaphragm has been completely installed and connected.

D. Forms: Place forms to minimize damage to casting slab surface.
   1. Use rigid forms, constructed to maintain tilt-up unit uniform in shape, size and finish.
   2. Formwork bracing brackets with double sided tape shall be adhered to floor slabs. No anchors shall be used to penetrate the slab.

E. Reveals: Extruded polystyrene foam or medium density fiberboard shall be accurately cut, laid out and adhered to the floor slab.

F. Floor Protection Inserts: In order to protect the floor during panel erection, install intermittent PVC floor protection inserts at all bottom outside panel edges in accordance with manufacturer's recommendations.

3.3 FORMING PANELS

A. Lay out panels in manner that will minimize joints in panel faces. Coordinate installation of inserts and anchorages.

B. Maintain consistent quality during construction of forms.

C. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

D. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items as indicated.

E. Locate hoisting devices to permit removal after erection.

F. Work concrete thoroughly around reinforcement, around embedded items, and into corners of the forms. Consolidate concrete in accordance with ACI recommendations.

G. Cold joints are not permitted in any individual panel.

3.4 PLACING AND CURING CONCRETE

A. Mix and deliver concrete in accordance with ASTM C94/C94M, Option A, and in compliance with recommendations of ACI 304R.

B. Protect freshly placed concrete from premature drying and excessively hot or cold temperatures.

C. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

3.5 FINISHING CONCRETE

A. Exterior Surfaces: Shall have a smooth finish with all fins removed. Surfaces shall be left ready to receive coatings.

B. Interior Surfaces: Exposed surfaces shall have a smooth steel trowel finish.

C. All defects, which are exposed to view, shall be corrected before final finish. All visible returns, edges, etc. shall be patched, rubbed, and otherwise finished to match adjacent surfaces.

D. Patch panels with grout where lifting hooks or other devices have been removed. Plastic insert covers are not acceptable.

3.6 SITE FABRICATION TOLERANCES

A. Unless otherwise approved by Architect, provide panels conforming to casting tolerances as specified below.

B. Panel Height and Width:
   1. Up to 20 feet: 1/4 inch maximum.
   2. 20 to 30 feet: 3/8 inch maximum.
   3. Each additional 10 ft increment: 1/8 inch maximum.

C. Panel Thickness: 3/16 inch maximum average variation through any vertical or horizontal cross section.

D. Skew of Panel or Opening: Measured as difference in length of the two diagonals:
   1. Per 6 feet of diagonal dimension: 1/8 inch maximum.
   2. Maximum total difference: 1/2 inch.

E. Panel Openings:
   1. Size: 1/4 inch maximum.
   2. Location of Centerline: 1/4 inch maximum.
   3. Size: 1/4 inch maximum.
   4. Location of Centerline: 1/4 inch maximum.

F. Location and Placement of Embedded Items:
   1. Inserts, Bolts, and Pipe Sleeves: 3/8 inch.
   2. Lifting and Bracing Inserts: As specified by manufacturer.
   3. Weld Plate Embedments: 1 inch for location; 1/4 inch for tipping and flushness.

G. Maximum Out of Square: 1/8 inch in 10 feet, non-cumulative.

H. Variation From Dimensions Indicated on Shop Drawings: Plus or minus 1/8 inch.

I. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch.

J. Maximum Bowing of Units: Length of bow/ 360.

3.7 DEFECTIVE CONCRETE

A. Defective Concrete: If test results indicate concrete not conforming to specified requirements, Contractor with the agreement of Architect must adjust mix to provide acceptable concrete on subsequent work. For concrete not meeting specified requirements, Owner may require core specimens to be taken and tested, at Contractor's expense. Concrete cores that test below specified requirements will be deemed to be defective.

B. Repair or replacement of defective concrete will be determined by the Architect and will be paid for by Contractor. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Any demolition or repair of other materials or systems as a result of repair or replacement of defective concrete shall be at the Contractor's expense.

D. Do not patch, fill, touch-up, repair, or replace damaged or defective concrete except upon express direction of Architect for each individual area.

3.8 ERECTION

A. Before beginning erection operations, verify that site conditions are appropriate for the work. Mark elements to conform to designations indicated on approved shop drawings.

B. Employ erection equipment that will prevent damage to existing construction, permanent floor slabs, and tilt-up panels. Protect panels to prevent staining, warping, or cracking.

C. Erect cast components in accordance with approved Shop Drawings. Do not erect tilt-up panels until a minimum strength has been reached of 2,500 psi or as required by the lifting insert manufacturer. Take all precautions necessary to prevent damage to panels.

D. Apply bond breaker adequately to ensure minimum resistance when lifting the panels off the casting surface.

E. Erection: Use erection equipment sized to handle the heaviest panel load. Operate equipment and adequately shore outriggers.
   1. Erection crane may run on top of panels on the floor slab. Provide tarps or protective barrier to prevent tire marks on interior surface of wall panels. Operate equipment and adequately shore outriggers, taking care to prevent damage to floor slabs. Repair floor slab cracks and damage as directed in Section 03 3513 - High-Tolerance Concrete Floor Finishing.

F. Raise and lift panels and erect plumb in accurate location and alignment. Do not drag or bounce panels across floor slab. Use wedges and shims where required to correctly position panels. Provide grout between panels and foundation system.

G. After placing, provide temporary braces and supports to securely hold panels in position. Maintain braces and supports in place, undisturbed, until closures, columns, or other supporting structures have been installed and are capable of receiving panels. Use of manufacturer specified or approved brace anchors at all bracing points shall be required. Wedge anchors or expansion bolts by others is not acceptable.
   1. All slab anchors shall be torqued to the required specification and certified by the installing contractor. All slab anchors must be re-torqued and re-certified following exposure to winds in excess of 35 mph.

H. Holes caused by installation of temporary braces anchored to floor slabs shall be patched with structural polymer adhesive, flush and smooth with floor surface. Color shall closely match concrete color. Provide mockup of patch for Architect approval prior to beginning work.

I. Good floor slab cosmetics are a primary concern. It is the Contractor's responsibility to employ sufficient means during the pouring, lifting, and setting of the tilt panels to avoid any damage including, but not limited to, scratching, marring, gouging, delaminating, and cracking to the permanent slab on grade. Damaged slab-on-grade sections shall be replaced solely at the Contractor's expense.

3.9 ERECTION TOLERANCES

A. Unless otherwise approved by Architect, install site-cast tilt-up panels within erection tolerances as specified below.

B. Replace panels that cannot be installed within specified tolerances.

C. Joint Width Variation:
   1. Up to 20 feet tall panels: 1/4 inch maximum.
   2. Each additional 10 ft increment: 1/8 inch maximum.
   3. Do not increase or decrease joint width more than 50 percent from specified joint width in any case, as measured between panels at exterior face.

D. Joint Taper:
   1. Up to 20 feet tall panels: 1/4 inch maximum.
   2. Each additional 10 ft increment: 1/8 inch maximum.
   3. Maximum for entire length of panel: 3/8 inch width difference for non-parallel panel edges.

E. Panel Alignment:
   1. Horizontal and Vertical Joints: 1/4 inch maximum.
   2. Offset in Adjacent Exterior Panel Faces: 1/4 inch.

F. Panels shall be set plumb, level, true to line and grade, and in alignment with adjacent panels. Maximum allowable tolerance from panel face to panel face shall be 1/4". Allowable joints between panels shall be 3/4" nominal with no joint greater than 1-1/4" or less than 3/8".

3.10 CLEANING AND ADJUSTING

A. Adjust units as required to bring joint dimensions within allowable tolerances.

B. Replace damaged or defective panels and those that cannot be installed within specified tolerances.

C. Concrete improperly formed, not true, plumb or level, not to required elevations or containing cracks detrimental to structural integrity or appearance shall be repaired to the Engineer's satisfaction.

D. Immediately after removing forms, concrete surfaces shall be inspected. Any pour joints, voids, stone pockets, or other defective areas shall be patched as required by the Architect. The patching mortar shall consist of concrete materials with the coarse aggregate omitted. Thoroughly compact the mortar into place and screed off slightly higher than the surrounding area. After one to two hours patch shall be rubbed and finished to match the surrounding surface.

E. Chip or grind off all defective materials and foreign matter.

F. The joints between all panels shall be sealed with materials as specified in Section 07920.

END OF SECTION

SECTION 04 2000

UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete Block.

B. Mortar and Grout.

C. Reinforcement and Anchorage.

D. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.04 - LEED Material Content Form

B. Section 01 3516.05 - LEED New Product Source Form

C. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.

1.3 REFERENCE STANDARDS

A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.

B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.

C. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2012.

F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.

G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.

K. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

L. ASTM C476 - Standard Specification for Grout for Masonry; 2010.

M. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.

C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

D. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled content of masonry material furnished under this section.

1.5 QUALITY ASSURANCE

A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depth of 8 inches.
   2. Load-Bearing Units: ASTM C90, lightweight.
   3. Non-Loadbearing Units: ASTM C129.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I.
   1. Hydrated Lime: ASTM C207, Type S.
   2. Mortar Aggregate: ASTM C144.
   3. Grout Aggregate: ASTM C404.

B. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; uncoated finish.

B. Single Wythe Joint Reinforcement: Truss type; ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

2.4 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 MORTAR AND GROUT MIXES

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Interior, loadbearing masonry: Type S.
   2. Interior, non-loadbearing masonry: Type N.

B. Grout: ASTM C476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

3.4 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Interlock intersections and external corners.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Isolate masonry partitions from vertical structural framing members with a control joint.

3.5 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

A. Install horizontal joint reinforcement 16 inches on center.

B. Lap joint reinforcement ends minimum 6 inches.

3.6 LINTELS

A. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
   1. Openings to 40 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
   2. Openings from 40 inches to 64 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
   3. Openings from 64 inches to 88 inches: Place two, No. 6 reinforcing bars 1 inch from

bottom web.

4. Openings over 78 inches: Reinforce openings as detailed.

B. Maintain minimum 8 inch bearing on each side of opening. Minimum 16 inch bearing for openings greater than 88 inches.

3.7 GROUTED COMPONENTS

A. Lap splices minimum 24 bar diameters.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. Place and consolidate grout fill without displacing reinforcing.

3.8 CONTROL JOINTS

A. Do not continue horizontal joint reinforcement through control joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.9 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

B. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.13 CLEANING

A. Remove excess mortar and mortar droppings.

B. Clean soiled surfaces with cleaning solution.

C. Use non-metallic tools in cleaning operations.

END OF SECTION

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural steel framing members, support members.

B. Base plates, shear stud connectors.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED Material Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 01 4000 - Quality Requirements: Testing and inspection.

E. Section 05 2100 - Steel Joist Framing.

F. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

G. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.3 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2005.

B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.

C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2007.

G. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

H. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.

I. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength; 2012.

J. ASTM A490M - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric); 2012.

K. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2010a.

L. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a.

M. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric]; 2007.

N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.

O. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.

P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

R. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Indicate cambers and loads.
   3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

E. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content of steel material furnished under this section.

1.5 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."

B. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store structural steel members at project site above ground on platforms or skids. Do not place in contact with earth or concrete slabs. Store bolts and welding rods in original containers with labels intact.

B. Protect items from corrosion affecting structural strength and use.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Angles, Plates, and Channels: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M.

C. Cold-Formed Structural Tubing: ASTM A500, Grade B.

D. Pipe: ASTM A53/A53M, Grade B, Finish black.

E. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars, cold finished carbon steel, with dimensions complying with AISC Specifications.

F. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, medium carbon, plain.

G. Unfinished Bolts and Nuts: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.

H. High-Strength Structural Bolts: ASTM A490 (ASTM A490M), with matching ASTM A563 (ASTM A563M) nuts and ASTM F436 washers; Type 1 alloy steel.

I. Anchor Bolts: ASTM A 307, Grade C, non-headed type unless otherwise indicated.

J. Welding Materials: AWS D1.1; type required for materials being welded.

K. Shop and Touch-Up Primer: SSPC-Paint 15, Type 1, gray oxide, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Shop fabricate to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
   1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite and minimize field handling of materials.
   2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Develop required camber for members.

C. Connections: Weld or bolt shop connections as indicated.
   1. Bolt field connections, except where welded connections or other connections are indicated.
   2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
   3. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

D. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts". Bolts shall be installed with hardened washers under the element turned in tightening bolts to facilitate verification inspection

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built-up sections by methods which will produce true alignment of axis without warp.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Shop weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
   1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates. Remove burrs resulting from drilling operations.

I. Header Units: Provide header units to support tail joists at openings in floor or roof system unless otherwise indicated.

2.3 FINISH

A. Surface Preparation:

1. Clean all surfaces after fabrication and immediately prior to shop painting in accord with SSPC-SP2, Hand Tool Cleaning, SSPC- SP3, Power Tool Cleaning, or SSPC-SP6, Commercial Blast Cleaning at manufacturer's option.
2. Blast clean only when relative humidity is below 85% and when surface temperature of steel is a minimum of 5 degrees F. above the dew point. Remove all traces of blast residue and dust. Do not contaminate the surfaces. Require workmen to wear clean gloves when handling blast cleaned steel.

B. Shop Painting:
1. Apply specified shop coat in accord with manufacturer's product data to provide a minimum dry film thickness of 2.0 mils. Apply shop coat of paint within four hours after cleaning and before rust-bloom occurs. Paint only in relative humidity below 85% and surface temperatures of 5 degrees F. above dew point.
2. Apply lacquer to milled surfaces to dry film thickness of 0.5 mils.

C. Shop Painting Schedule: Paint all structural steel with a shop coat of paint, except:
1. Members encased in concrete.
2. Contact surfaces of welded connections and areas within 2" of field welds except as noted.
3. Contact surfaces of high-strength bolted connections.
4. Surfaces receiving sprayed-on fireproofing.
5. Surfaces receiving field welded steel studs.

PART 3 EXECUTION

3.1 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure within specified AISC tolerances.
2. Splice members only where indicated and accepted on shop drawings.
3. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.
4. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing unless acceptable to Architect/ Engineer. Finish gas-cut sections equal to a sheared appearance when permitted.

D. Do not field cut or alter structural members without approval of Architect.

3.2 TOUCH-UP PAINTING

A. After erection, clean and remove rust, dirt and other foreign matter from exposed surfaces of field connections, unpainted areas adjacent to field connections, and damaged areas in shop primer. Touch-up paint with primer to the same standards as required for the shop coat and paint using identical primer.

3.3 TOLERANCES

A. Level and plumb individual members of structure within specified AISC tolerances.

3.4 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing 100 percent of bolts at each connection.
   1. Load indicating washers or snap off bolts shall be 100 percent visually inspected.

C. Welded Connections: Visually inspect all field-welded connections.

D. Re-inspection shall be required for all failed tests.

END OF SECTION

SECTION 05 2100

STEEL JOIST FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Open web steel joists and joist girders and shear stud connectors, with bridging, attached seats and anchors.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED Material Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 01 4000 - Quality Requirements: Testing and inspection.

E. Section 05 1200 - Structural Steel Framing: Superstructure framing.

F. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches in decking.

G. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.3 REFERENCE STANDARDS

A. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2007.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2010.

D. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

F. SJI (SPEC) - Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute; 2011.

G. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; Steel Joist Institute; 2008.

H. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).

I. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

D. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content of steel material furnished under this section.

1.5 QUALITY ASSURANCE

A. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Provide joists fabricated in compliance with the following, and as herein specified.
   1. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, K Series"
   2. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, LH Series"
   3. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, DLH Series"
   4. Steel Joist Institute (SJI) "Standard Specifications for Joist Girders"

C. Inspect joists and joist girders in accordance with applicable SJI specifications.

D. Perform Work, including that for headers and other supplementary framing, in accordance with SJI Standard Specifications Load Tables and SJI Technical Digest No.9.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements. Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

B. Store steel joists at project site above ground on platforms or skids. Do not place in contact with earth or concrete slabs.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel: Comply with applicable SJI Specifications.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular hexagon type, low carbon steel.

C. High-Strength Threaded Fasteners: ASTM A325 or A490 heavy hexagon structural bolts with nuts and hardened washers.

D. Steel Prime Paint: Paint shall be manufacturers standard grey primer conforming to SJI "Standard Specifications", for the shop painting of steel joists

E. Anchor Bolts, Nuts and Washers: ASTM A 307, hot-dip galvanized per ASTM A 153/A 153M, Class C.

F. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars.

G. Welding Materials: AWS D1.1; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, Type 1, gray oxide, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. General: Fabricate steel joists and joist girders in accordance with applicable SJI Specifications.

B. Extended Ends: Provide extended ends on joists where shown, complying with manufacturer's standards and requirements of applicable SJI Specifications.

C. Bridging: Provide horizontal or diagonal type bridging for joists, complying with applicable SJI Specifications.
   1. Provide bridging anchors for ends of bridging lines terminating at walls or beams.
   2. Coordinate location of bridging with ESFR sprinkler heads to avoid obstruction conflicts.

D. Header Units: Header units to support tail joists at openings in floor and roof systems shall be provided in Section 05 1200 unless otherwise indicated.

2.3 FINISH

A. Shop prime joists as specified.

B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

C. Apply one shop coat of steel prime paint to joists, joist girders, and accessories by spray, dipping, or other methods to provide a continuous dry paint film thickness of not less than 1.0 mil.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.2 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

D. Coordinate placement of anchors in concrete construction for securing bearing plates, and angles.

E. Position and field weld joist chord extensions and wall attachments as detailed.

F. Do not permit erection of decking until joists are braced bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

G. Do not field cut or alter structural members without approval of joist manufacturer.

H. After erection, clean and remove rust, dirt an dother foreign matter from exposed surfaces including field connections. Prime welds, damaged shop primer, and surfaces not shop primed. Use same type of paints as used for shop painting.

3.3 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing 100 percent of all bolts.

C. Welded Connections: Visually inspect all field-welded connections.

D. Re-inspection shall be required for all failed tests.

END OF SECTION

SECTION 05 3100

STEEL DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof deck.

B. Floor deck.

C. Supplementary framing for openings up to and including 18 inches.

D. Bearing plates and angles.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED Material Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 05 5000 - Metal Fabrications:

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened; 2012

C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

D. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

E. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Provide metal roof deck units which have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for Class 1 fire rating.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

F. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content of steel material furnished under this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store deck on dry wood sleepers; slope for positive drainage.

B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.1 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet:
   1. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 80/550.
   2. Primer: SSPC-Paint 15, Type I, white primer paint over cleaned and phosphatized substrate. Comply with VOC limitations of authorities having jurisdiction.
   3. Minimum Metal Thickness, Excluding Finish: 22 gage or as indicated on the drawings.
   4. Nominal Height: 1-1/2 inch.
   5. Profile: Fluted, Type B wide rib.

2.2 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel.

B. Welding Materials: AWS D1.1.

C. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

2.3 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage thick sheet steel; of profile and size as indicated; finished same as deck.

B. Roof Sump Pans: 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.1 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and approved shop drawings. Align and level.

B. Placing of Decking:
   1. Position decking on supporting steel framework and adjust to final position with ends bearing on supporting members and aligned end-to-end before being permanently fastened. Roof decking shall be continuous over a minimum of three spans.
   2. Lap ends not less than 4 inches.
   3. Do not stretch or contract side lap interlocks.
   4. Place decking flat and square and secure to adjacent framing without warp or deflection.
   5. Install deck with corrugations running perpendicular to supports. Lay only as much deck as can be welded during same work period.

C. Fastening Decking - Welding:
   1. Secure decking to supporting members with 5/8 inch minimum diameter fusion welds at ends and at intermediate supports. See structural drawings for spacing requirements. Welds shall be free of sharp points or edges. Welding washers are required for deck thickness less than 0.028 inches thick.
   2. Welding shall conform to AWS D1.3.
   3. Lock side laps between deck supports. Side laps shall be made with self-tapping #10 sheet metal screws.

D. Fastening Decking - Mechanical Fasteners:
   1. Fasten deck to steel support members at ends and intermediate supports with

mechanical fasteners. See structural drawings for spacing requirements.
2. Follow manufacturers instructions utilizing installation tool and procedures.
3. Lock side laps between deck supports. Side laps shall be made with self-tapping #10 sheet metal screws.

E. Cutting and Fitting:
1. Cut and fit decking and accessories around projections through decking.
2. Make cuts neat, square and trim.
3. Cut openings in deck true to dimensions using metal saws, drills or cutting torches.
4. Reinforce cuts in decking as indicated on structural drawings.

F. Allow no decking to be used for storage or working platforms until permanently secured in position. Limit loading after securing in place to 20 psf.

G. No decking showing signs of rust shall be installed.

H. At deck openings from 6 inches to 18 inches in size, provide 2 x 2 x 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.

I. Where deck changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

J. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

K. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

L. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

M. After erection, clean and remove rust, dirt and other foreign matter from exposed surfaces including field connections. Touch-up paint with primer to the same standards as required for the shop coat and paint using identical primer.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01400.

B. Welded Connections: Visually inspect all field-welded connections.

END OF SECTION

SECTION 05 5000

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items, including:
   1. Ship ladders.
   2. Steel ladder and safety cage.
   3. Barrier rails.
   4. Bollards.
   5. Miscellaneous steel framing and supports.
   6. Roof opening framing.
   7. Concrete edge confinement angles.
   8. Downspout guards.
   9. Concrete stair tread nosings.
   10. Steel support for moveable partitions.
   11.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.03 - LEED Metal-Containing Product List

B. Section 01 3516.04 - LEED Material Content Form

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

E. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.

F. Section 05 2100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.

G. Section 05 3100 - Metal Deck: Bearing plates for metal deck bearing, including anchorage.

H. Section 05 5100 - Metal stairs, handrails and railings.

I. Section 09 9000 - Painting and Coating: Paint finish.

J. Section 10 7320 - Dock Canopy: Cantilevered structural steel support.

1.3 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2012.

G. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

H. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.

I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2010a.

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

L. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).

M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.4 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

C. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled steel content of steel material furnished under this section.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel".

1.6 SEQUENCING AND SCHEDULING

A. Shop Assembly: Preassemble metal fabrications in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark fabricated units for reassembly and coordinated installation.

B. Schedule production and site delivery of metal fabrications so as to avoid delay to other work in which such fabrication are incorporated, and to avoid encumbering site with stored materials.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500, Grade B cold-formed structural tubing.

C. Plates: ASTM A283.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Fasteners: Provide zinc coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required..

F. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Remove sharp or rough areas on exposed traffic surfaces.

F. Weld corners and seams continuously to comply with AWS recommendations.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

I. Clearly mark shop assembled and disassembled units for reassembly and coordinated installation.

J. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

L. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish. Unless otherwise shown, provide the following:
   1. Side Rails: 3/8 x 2-1/2 inches, flat bar members with eased edges, spaced at 18 inches.
   2. Rungs: 3/4 inch diameter deformed solid round bar spaced 12 inches on center.
   3. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
   4. Support each ladder at top and bottom and at intermediate points spaced not more than

5 feet o.c. Use welded or bolted steel brackets, designed for adequate support and anchorage and to hold the ladder clear of the wall surface with a minimum of 7 inch clearance from wall to centerline of rungs.

5. Except at roof hatch, extend rails 42 inches above top rung and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.
6. Provide OSHA approved safety cage where shown.

B. Barrier Rails: Schedule 40 steel pipe and steel channel sections, as detailed; prime paint finish.

C. Bollards: Schedule 40 steel pipe, concrete filled, crowned cap, as detailed; galvanized finish on exterior and prime paint finish on interior.

D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

E. Roof Opening Framing: As detailed; prime paint finish.
1. Unless otherwise indicated, provide frame for roof openings 12 x 12 inches or larger in size. Infill frame with 1/2 inch diameter steel bars spaced not over 12 inches on center both ways, unless otherwise indicated.

F. Concrete Edge Confinement Angles: Steel angles; prime paint finish.
1. Provide loose structural steel angles with integral anchor bolts for confinement and protection of exposed concrete edges as shown. Weld anchor bolts to angles with equivalent of 3/16 inch full perimeter fillet welds and space as shown, but not closer than 4 inches from ends and corners.
2. Drill and tap angle legs for 1/4 inch by 20 machine screw connection to concrete forms. Provide anchorages at not greater than 48 inches o.c.
3. Miter cut angle legs to form corners and multiple edge intersections as shown.

G. Downspout Guards: As detailed; galvanized finish.

H. Ship Ladder: As detailed, prime painted finish.

I. Stair Tread Nosing: Stair nosings shall be equal to type No.BF311D as manufactured by American Safety Tread Company, Helena, Alabama 35080.Telephone 1-800-245-4881. The base shall consist of heat treated extruded aluminum alloy 6063-T6. The abrasive filler shall consist of a mixture of aluminum oxide and silicon carbide granules in an epoxy matrix. Nosings shall terminate not more than 3" from ends of steps for poured concrete stairs; for concrete filled steel pan stairs, nosings shall be full length of steps less 1/8" clearance. Color shall be as selected by the Architect.

2.4 FINISHES - STEEL

A. Prime paint all steel items except where indicated otherwise.
1. Exceptions: Galvanize items to be embedded in concrete or masonry.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat, gray metal primer, or approved equal, applied to a minimum dry film thickness of 2.0 mils.

D. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.2 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.3 INSTALLATION OF BOLLARDS AND BARRIER RAILS

A. Temporarily support bollards and barrier posts plumb in each direction and cast integrally with monolithic footings.

B. Fill bollards and barrier posts with 3,000 psi min. 28 day compressive strength concrete as specified under Section 03300, "Cast-in-Place Concrete". Form top with compacted smooth and convex surface to shed water.

END OF SECTION

SECTION 05 5100

METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stairs with metal treads.

B. Stairs with grating treads.

C. Structural steel stair framing and supports.

D. Handrails and guards.

1.2 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications.

B. Section 09 9000 - Painting and Coating: Paint finish.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

F. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2009.

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2010a.

H. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2007.

I. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2005 (Reapproved 2009).

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

L. NAAMM AMP 510 - Metal Stairs Manual; The National Association of Architectural Metal Manufacturers; 1992, Fifth Edition.

M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

N. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.4 DESIGN REQUIREMENTS

A. Design and fabricate stair assembly to support a uniform live load of 100 lb/sq ft and a concentrated load of 300 lb on an area of 4 square inches, with deflection of stringer or landing framing not to exceed 1/180 of span.

B. Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads:
   1. Top Rail of Guardrail: Uniform load of 50 pounds per linear foot applied in any direction at the top, and a concentrated load of 200 pounds applied in any direction at any point along the top. The concentrated and uniform loads need not be assumed to act concurrently.
   2. Infill Area of Guardrail: Horizontal load of 50 pounds on an area not to exceed 1 square foot, including openings and space between rails. This load need not be assumed to act concurrently with loads on top rails of railing system in determining stress on guard.

1.5 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing steel stairs similar to those indicated for this Project with a record of successful in service performance.

B. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
   2. Dimensions: As indicated on drawings.
   3. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
   4. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
   5. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
   1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
      a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
      b. Welds Exposed to View: Ground smooth and flush.
      c. Mechanical Joints: Butted tight, flush, and hairline.
      d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
      e. Exposed Edges and Corners: Eased to small uniform radius.
      f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 INTERIOR METAL STAIRS WITH METAL TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Checkered steel plate.
   1. Tread Thickness: 1/4 inch, minimum.
   2. Nosing: Plate bent to minimum radius with down return of 1 inch.
   3. Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.

D. Risers: Steel sheet.
   1. Riser Thickness: As required by design; 14 gage, 0.075 inch minimum.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish for Interior Locations: Shop- or factory-prime painted.

2.3 EXTERIOR METAL STAIRS WITH GRATING TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Grip Strut Safety Grating, regular duty, with slip resistant serrated surface.
   1. Galvanized Steel - hot-dip galvanized before fabrication, ASTM A525 (G-90) standard.
   2. Height: 1-1/2 inches.
   3. Gage: 12 gage or as required for span.

D. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

E. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

F. Railings: Steel pipe railings.

G. Finish: Galvanized after fabrication.

2.4 WELDED PIPE HANDRAILS AND GUARDS

A. Wall-Mounted Handrails: Round pipe rails unless otherwise indicated.
   1. Nominal Diameter: 1-1/4 inch.

B. Guards:
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Nominal Diameter: 2 inch.
   2. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
      a. Pipe Nominal Diameter: 2 inch.
      b. Material: Steel pipe or tube, round.

c. Jointing: Welded and ground smooth and flush.

3. End and Intermediate Posts: Same material and size as top rails.
   a. Horizontal Spacing: As indicated on drawings.
   b. Mounting: Welded to top surface of stringer.

C. Fabrication:
1. Fabricate pipe handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
2. Interconnect railing and handrail members by butt welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
   a. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, and weld all around.
3. Form changes in direction of handrails and rails as follows:
   a. By welding in prefabricated flush elbow fittings.
   b. By radius bends of radius indicated.
   c. By flush radius bends.
   d. By bending.
   e. By any method indicated above, applicable to change of direction involved.
4. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
5. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
6. Close exposed ends of pipe by welding 3/16-inch- (4.8-mm-) thick steel plate in place or with prefabricated fittings.
7. Locate drain or vent holes in pipe in inconspicuous locations. Plug all holes before delivery to site.
8. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and railing systems to other work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.

2.5 PRE-FABRICATED BOLTED GUARDRAIL

A. Posts: 2 x 2 x .188 inch square steel tube.

B. Horizontal Rails: Nominal 1-1/4 round steel pipe.

C. Miscellaneous:
1. 2-1/2 x 7 gage steel saddle with rounded edges to connect rail to post. Weld saddle to post and attach rail with (2) #5 12-24 tek screws.
2. Plastic inserts to cap top and bottom of posts.

D. Bolts: ASTM A307, 1/2 inch diameter.

E. Rail Connectors: Guardrail shall be constructed with Speed-Rail slip-on/ bolt-on structural pipe fittings, manufactured by The Hollaender Mfg Company, or equal. Fittings shall be high-tensile aluminum-magnesium alloy, manufactured in compliance with ASTM B26, cast from high purity ingot 535.2 that conforms to ASTM B179. All fittings shall be securely fastend to the pipe set screws.
1. Finish: Mill finish.

F. Guardrail rails and posts shall be powder coated safety yellow color.

2.6 MATERIALS

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A500 or ASTM A501 structural tubing, round and shapes as indicated.

C. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.

D. Steel Plates: ASTM A 283.

E. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

F. Checkered Plate: ASTM A786/A786M, rolled steel floor plate; pattern no. 2.

G. Steel Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.

H. Steel Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.

I. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.

J. Welding Materials: AWS D1.1; type required for materials being welded.

K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.7 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting of Interior Metals: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One.

D. Galvanizing of Exterior Metals: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval prior to site cutting or creating adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except

surfaces to be in contact with concrete.

3.3 INSTALLING WELDED STEEL PIPE RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
   1. Anchor posts to steel by welding directly to steel supporting members.
   2. Anchor handrail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with drilled-in expansion anchors.

B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with minimum 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
   1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
   2. For concrete and solid masonry anchorage, use drilled in expansion anchor.

3.4 INSTALLING BOLTED STEEL PIPE RAILINGS

A. Space posts at spacing indicated, as dictated by conveyor obstructions, and as required by design loadings. Plumb posts in each direction. Bolt posts to mounting plate and toerail.

B. Bolt horizontal rails to vertical posts. Railings to be level.

C. Use slip-on bolted connectors to join railing members. Fabricate rail sections such that maximum run of connected railing is no greater than 57 feet.

3.5 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 06 1000

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof-mounted curbs.

B. Roofing nailers.

C. Preservative treated wood materials.

D. Fire retardant treated wood materials.

E. Communications and electrical room mounting boards.

F. Concealed wood blocking, nailers, and supports.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.02 - LEED Wood-Containing Product List

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

C. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood Protection Association; 2003.

D. AWPA C20 - Structural Lumber -- Fire Retardant Treatment by Pressure Processes; American Wood-Protection Association; 2003.

E. AWPA C27 - Plywood -- Fire-Retardant Treatment by Pressure Processes; American Wood-Protection Association; 2002.

F. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2010.

G. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

H. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. LEED Reports: Submit letter identifying harvesting and manufacturing location for wood material furnished under this section.
   1. Furnish Forest Stewardship Council (FSC) Chain-of-Custody certificate number for FSC wood permanently installed in project.
   2. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

C. Provide sustainably harvested wood; see Section 01 6000 for requirements.

2.2 DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

A. Products shall not contain any added urea-formaldehyde binder or resins (NAUF).

B. Wall Sheathing: APA PRP-108, Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
   1. Span Rating: 24/0.
   2. Thickness: 3/4 inch, nominal.

C. Communications and Electrical Room Mounting Boards: APA rated sheathing, A-D or better, fire retardant treated; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E 84.

2.4 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

B. Fire Retardant Treatment:

1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    b. Treat rough carpentry items as indicated .
    c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
    1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    2. Treat lumber in contact with roofing, flashing, or waterproofing.
    3. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 INSPECTION:

A. Verify that surfaces to receive rough carpentry materials are prepared to required grades and dimensions.

3.3 INSTALLATION:

A. General:
    1. Accurately cut and fit items with close joints to proper plane and alignment.
    2. Rigidly secure members, free of warp or bend to maintain proper alignment and to adequately resist design loads.
    3. Linear runs of material shall be formed using lengths as great as practicable.
    4. Where multiple members are used to form linear runs, offset joints in member not less than 3 feet.
    5. Roof nailer height shall match the total thickness of insulation being used and shall be installed with a 1/8 inch gap between each length or change of direction.
    6. Roof nailers shall be anchored with fasteners suitable for the application having a minimum withdrawal resistance of 100 lb, staggered 6 inches on center within 8 feet of an outside corners and 12 inches on center along other perimeter areas.

B. Pressure-Treated Wood Products:
    1. Provide pressure-treated wood for all framing, blocking, furring, nailing strips built into masonry walls and wood in contact with concrete.
    2. Install pressure treated wood nailers in locations required by roofing manufacturer including but not limited to:
        a. Perimeter of the roof with gutter.
        b. Base of roof projections.
        c. All roof penetrations.
        d. Expansion joints.
    3. Re-dry and clean lumber, after treatment, to maximum moisture content of 19%,

stamped "DRY".

4. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Specifically, provide the following non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Toilet partitions.
   7. Audio-visual components.
   8. Chalkboards and marker boards.
   9. Wall paneling and trim.
   10. Joints of rigid wall coverings that occur between studs.

3.5 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.
   4. Size and Location: As indicated on drawings.

END OF SECTION

SECTION 06 1500

WOOD DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resin deck mezzanine floor panels.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.02 - LEED Wood-Containing Product List

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials.

C. LEED Reports: Submit letter identifying harvesting and manufacturing location for wood material furnished under this section.
   1. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cornerstone Specialty Wood Products.
   1. ResinDek LD, 3/4 inch thick.

2.2 WOOD MATERIALS

A. Products shall not contain any added urea-formaldehyde binder or resins (NAUF).

B. ResinDek: Composed of wood fibers, various resins and finish coating.
   1. Thickness: 3/4 inch.
   2. Live Dead Pallet Jack Limits: 2,000 lbs.
   3. Edges: Tongue and groove.
   4. Finish: Gray Diamond Seal.

2.3 ACCESSORIES

A. Fasteners and Anchors:
   1. Fastener type and finish as recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that support framing is ready to receive decking.

3.2 INSTALLATION

A. Follow manufacturer's written instructions for installation over corrugated B-decking.

B. Panel joints must align over high point (rib) of metal decking.

C. Manufacturer approved screws must be driven just below the panel surface.

D. Provide panel spacers to insure proper gap between boards.

3.3 CLEANING

A. Clean panels using methods recommended by manufacturer.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Cabinet hardware.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.02 - LEED Wood-Containing Product List

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.3 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard; 2004.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.

C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.

D. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.

E. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit samples of plastic laminate materials.

E. LEED Reports: Submit letter identifying harvesting and manufacturing location for wood material furnished under this section.
   1. Furnish Forest Stewardship Council (FSC) Chain-of-Custody certificate number for FSC wood permanently installed in project.
   2. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.7 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI Architectural Woodwork Standards for Custom Grade.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Composite wood products shall contain no added urea-formaldehyde binder or resins (NAUF).

C. Laminating adhesives used to fabricate on-site and shop-applied composite wood assemblies shall contain no added urea-formaldehyde binder or resins (NAUF).

D. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000.

2.3 LUMBER MATERIALS

A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade III/Economy; average moisture content of 5-10 percent.
   1. Semi-Exposed Surfaces: Species - clear fir.
   2. Internal Construction: Species - white pine.

2.4 PANEL MATERIALS

A. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with interior grade adhesive under heat and pressure; sanded faces; thickness as required; use for all components not indicated as another material.

B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with interior grade adhesive to suit application; sanded faces; thickness as required.
   1. Use for painted components and components indicated on the drawings.
   2. Use as backing for plastic laminate unless otherwise indicated.

C. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S); use for gables and backs.

2.5 LAMINATE MATERIALS

A. Provide specific types as scheduled.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for

specific applications and as follows:
1. General Surfaces: HGS, 0.048 inch nominal thickness, colors as scheduled, finish as scheduled.
2. Cabinet Liner: CLS, 0.020 inch nominal thickness, white color,.
3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.6 ENGINEERED STONE COUNTERTOP MATERIALS

A. Acceptable Manufacturers:
   1. Silestone.

B. Provide specific types as scheduled.

C. Thickness: 3/4 inch.

2.7 ACCESSORIES

A. Adhesive: Type recommended by AWI/AWMAC to suit application and shall contain no added urea-formaldehyde binder or resins (NAUF).

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel, or chrome-plated finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.8 HARDWARE

A. Adjustable Cabinet Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.

B. Adjustable Shelving Supports: Heavy duty back-mounted system using surface mounted metal shelf standards and coordinated heavy duty cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments. Include clips to screw shelf bracket to shelf.

C. Drawer and Door Pulls: "U" shaped wire pull, plastic of standard color, 4 inch centers. Color to be selected by Architect.

D. Catches: Magnetic.

E. Drawer Slides:
   1. Type: Standard extension.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.

F. Hinges: Concealed (fully mortised) self-closing type, steel with satin finish.

G. Sliding Glass Track Assemblies: Upper and lower track of satin anodized aluminum.

2.9 FABRICATION

A. Cabinet Style: Flush overlay.

B. Cabinet Doors and Drawer Fronts: Flush style.

C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

D. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for

cutting. Provide matching trim for scribing and site cutting.

E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

F. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.

G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 PREPARATION

A. AWI Standard: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

B. Conditioning: Condition woodwork to average prevailing humidity conditions for a minimum of seven (7) days in installation areas before installing.

C. Inserts: Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

D. Examination of Woodwork: Before installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.3 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level. Install to a tolerance of 1/8 inch in 8 feet for plumb and level (including countertops); and with 1/16 inch maximum offset in flush adjoining surfaces.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

3.4 ADJUSTING

A. Adjust installed work.

B. Maximum clearance between doors or jambs and cabinet doors shall not exceed 1/16 inch.

C. Adjust moving or operating parts to function smoothly and correctly.

3.5 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 2100

THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rigid Wall Insulation.

B. Batt Insulation.

1.2 RELATED REQUIREMENTS

A. Section 07 5400: Board insulation specified as part of roof system.

B. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.3 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2012.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.1 RIGID WALL INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289; Type I, aluminum foil both faces; Class 1, non-reinforced foam core.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   4. Facing: 1.25 mil white embossed aluminum on one face and 1.25 mil embossed aluminum on the other face.
   5. Board Size: 4 feet wide by longest length practical, to minimize joints.
   6. Board Thickness: 1 inch.
   7. Board Edges: Square.
   8. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E 84.
   9. Large Scale Testing: Class 1 wall panel when tested in accordance with Factory Mutual Standard 4880, UL 1040 or UL 1715.
   10. Manufacturers:
      a. Dow Chemical Co: Thermax Light Duty.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Fasteners: White plastic mechanical fastening washer, equal to Buildex "Grid-Mate", with Tapcon masonry anchors of length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place. Seat washers flush with or maximum 1/16

inch below insulation surface.

2.2 BATT INSULATION MATERIALS

A. Batt Insulation at metal stud framed walls:
   1. Type: Fiberglass insulation equal to Owens Corning Insulation "Flamespread 25".
   2. Thickness: 3-1/2 inch.
   3. Minimum R Value: 11.
   4. Vapor Barrier: Foil scrim faced with flame spread rating not to exceed 25 and maximum smoke developed of 50.

B. Exposed Insulation attached to inside face of wall and at soffit:
   1. Type: Fiberglass insulation equal to Owens Corning Insulation "Flamespread 25".
   2. Thickness: 6 inch.
   3. Minimum R Value: 19.
   4. Vapor Barrier: Foil scrim faced with flame spread rating not to exceed 25 and maximum smoke developed of 50.

PART 3 EXECUTION

3.1 BOARD INSTALLATION AT EXTERIOR WALLS

A. Cut and fit insulation board tightly to protrusions or interruptions to the insulation plane.

B. Install insulation board to wall with plastic fastening washers and Tapcon anchors. Washers shall be equally spaced at a rate of approximately 1 fastener per 8 square feet of board.

C. Install "J" trim at all exposed edges of insulation.

D. Install insulation board vertically. Apply matching foil faced tape over all seams.

3.2 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Walls and Soffits with Metal Stud Framing:
   1. Install insulation with vapor barrier towards building interior.
   2. Use friction fit between framing members.

F. Exposed Insulation Attached to Concrete Walls:
   1. Install insulation with vapor barrier towards building interior.
   2. Install batt insulation to wall with insulation hangers and plastic washers. Hangers shall be equally spaced at a rate of approximately 1 fastener per 8 square feet of wall area.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.3 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2616

VAPOR RETARDER

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Vapor retarder to be placed under interior concrete slabs on grade where indicated.

1.2 REFERENCES:

A. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials, 2005.

B. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2009.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's product literature and instructions for vapor barrier material and mastic.

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to project site in manufacturer's original packaging or containers.

B. Store to prevent damage, deterioration or contamination.

PART 2 - PRODUCTS

2.1 VAPOR RETARDER:

A. Acceptable Manufacturer:
   1. Stego Industries: Stego Wrap Class A Vapor Retarder.
   2. Fortifiber Industries: Moistop Ultra 10.
   3. Raven Industries: VaporBlock 10

B. Requirements:
   1. Permeance of 0.03 or less perms as tested in accordance with ASTM E 96.
   2. Strength: Class A requirements of ASTM E 1745.
   3. Minimum Thickness: 10 mil.

C. Adhesive or Tape: Acceptable to manufacturer of vapor barrier material.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install vapor barrier over compacted, clean subgrade material, free of debris and protrusions.

B. Lay vapor barrier over interior building area to receive concrete slab; lap edges 6" minimum and seal with manufactuer's tape. Lay membrane with seams perpendicular to and lapped in direction of pour. Turn edges of membrane up to within 1/2" of top of slab at intersection with vertical surfaces.

C. Where expansion or control joints are indicated in slab, lay vapor barrier continuous under joint filler.

D. Seal openings in vapor barrier around pipes and other protrusions per manufacturer's instructions. Fold at corners to form envelopes.

E. Protect vapor barrier installation from damage until concrete slab is in place.

END OF SECTION

SECTION 07 4264

METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.

1.2 RELATED REQUIREMENTS

A. Section 07 9005 - Joint Sealers.

1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes; 2010.

E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2012.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.

H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010.

I. ASTM D523 - Standard Test Method for Specular Gloss; 2008.

J. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).

K. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2012.

L. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates; 2011.

M. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010.

N. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007.

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

P. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
   3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   4. Review procedures for protection of work and other construction.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

F. Installer's Qualifications.

G. Maintenance Data: Care of finishes and warranty requirements.

H. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of Work and licensed in the State in which the Project is located.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum 3 years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.

2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.
4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
1. Store in well ventilated space out of direct sunlight.
2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
3. Store at a slope to ensure positive drainage of any accumulated water.
4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 10 years:
1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Composite Material Sheet Manufacturers:
1. Alcan Composites USA, Inc; : www.alucobondusa.com.
2. Alcoa, Inc; : www.alcoa.com.
3. ALPOLIC Materials; : www.alpolic-usa.com.

2.2 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
2. Provide panel jointing and weatherseal using a "wet," sealant sealed system.
3. Anchor panels to supporting framing without exposed fasteners.

B. Performance Requirements:
1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
2. Wind Performance: Provide system tested in accordance with ASTM E330 without permanent deformation or failures of structural members under the following conditions:
a. Inward Design Wind Pressure: 25 psf.
b. Outward Design Wind Pressure: 25 psf.
c. Maximum deflection of perimeter framing member of L/175 normal to plane of the

wall; maximum deflection of individual panels of L/60.

d. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.

2.3 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
   1. Overall Sheet Thickness: 4 mm.
   2. Face Sheet Thickness: 0.019 inches, minimum.
   3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
   4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   6. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
   7. Factory Finish: One coat fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
      a. Coating Flexibility: Pass ASTM D4145 minimum 1T-bend, at time of manufacturing.
      b. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.
   8. Color: Custom color to match PMS 186-C HomeGoods Red.

B. Metal Framing Members: Include all sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
   1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
   2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
   3. Stainless Steel Sheet Components: ASTM A480/A480M.

C. Anchors, Clips and Accessories: Use one of the following:
   1. Stainless steel complying with ASTM A480/A480M, ASTM A276 or ASTM A666.
   2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
   3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.

D. Fasteners:
   1. Exposed fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
   2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   3. Bolts: Stainless steel.

E. Provide panel system manufacturer's and installer’s standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.3 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Where joints are designed for field applied sealant, seal joints completely with specified sealant.

H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

I. Replace damaged products.

3.4 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 5400

THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mechanically attached and fully adhered system with thermoplastic roofing membrane.

B. Insulation, flat.

C. Flashings.

D. Roofing stack boots, roofing expansion joints, and walkway pads.

E. This is a Factory Mutual Global indexed project.

1.2 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Installation Meeting.

B. Section 01 3516.04 - LEED Material Content Form.

C. Section 01 3516.05 - LEED New Product Source Form

D. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.

E. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings.

F. Section 07 7200 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.3 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2012.

B. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2011a.

C. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011.

D. FM DS 1-28 - Wind Design; Factory Mutual Research Corporation; 2007.

E. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene two weeks before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.
   1. LEED Submittal: Include testing documentation of solar reflectance index.
   2. Provide documentation that roof system is a FM Global approved system.

C. Specimen Warranty: For approval.

D. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and mechanical fastener layout.

E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. LEED Reports: Submit letter identifying manufacturing location and percentage of recycled content of roof membrane and roof insulation board furnished under this section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section:
   1. Approved by membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

C. Protect foam insulation from direct exposure to sunlight.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. System Warranty: Provide manufacturer's total system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. The maximum wind speed coverage shall be peak gusts of 72 mph measured at 30 feet above ground level.
   4. Pro-rated membrane system warranties shall not be accepted.
   5. The roofing system manufacturer’s warranty shall include roof edge metal and the installation of that edge metal in the warranty. See Section 07 6200 - Sheet Metal Flashing and Trim.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Thermoplastic Polyolefin Membrane Materials:
   1. Carlisle SynTec; : www.carlisle-syntec.com.
   2. Firestone Building Products Co; : www.firestonebpco.com.
   3. GAF Materials Corporation: www.gaf.com.
   4. GenFlex Roofing Systems; : www.genflex.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, mechanically fastened and fully adhered, over insulation.

B. Roofing Assembly Requirements:
   1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
      a. Field applied coating may not be used to achieve specified SRI.

2. Roof Covering External Fire-Resistance Classification: UL Class C.
3. Factory Mutual Classification: Class I and windstorm resistance of I-90, in accordance with FM DS 1-28.
4. Insulation Thermal Value (R), minimum: R-15.3; provide insulation of thickness required.

C. Acceptable Insulation Types - Constant Thickness Application:
1. Minimum 2 layers of polyisocyanurate board.

2.3 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
1. Material: Thermoplastic polyolefin (TPO) complying with ASTM D6878.
2. Reinforcing: Internal fabric.
3. Thickness: 0.060 inch minimum, except over the Low Bay Warehouse roof area membrane shall be minimum 0.080 inch.
4. Sheet Width: Maximum 10 feet, factory fabricated.
5. Solar Reflectance: 0.79, minimum, when tested in accordance with ASTM C 1549.
6. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended and approved by membrane manufacturer.

D. Flexible Flashing Material: Material recommended by membrane manufacturer.

2.4 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 1, glass fiber mat both sides.
1. Size: 48 inches by 96 inches, nominal.
a. Exception: Insulation to be attached using adhesive or asphalt may be no larger than 48 inches by 48 inches, nominal.
2. R-Value (LTTR):
a. Two layers - total R-Value 30.0 minimum.
b. Provide alternate for two layers - total R-Value 18.0 minimum.
3. Compressive Strength: 20 psi (138 kPa) when tested in accordance with ASTM C 1289.
4. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
5. Provide tapered boards where indicated for sloping to drain. Fabricate with taper of 1/2 inch per foot, unless indicated otherwise.

B. High Density Polyisocyanurate Cover Board at Low Bay Warehouse only: Non-combustible, water resistant high density, closed cell polyisocyanurate core with coated glass mat facers, complying with ASTM D 1623, and with the following additional characteristics:
1. Size: 48 inches by 48 inches, nominal.
2. Thickness: 0.5 inch.
3. Surface Water Absorption: <3%, maximum, when tested in accordance with ASTM C 209.
4. Compressive Strength: 120psi, when tested in accordance with ASTM 1621.
5. Density: 5pcf, when tested in accordance with ASTM 1622.
6. R-Value: 2.5 based on ASTM tests C158 and C177.
7. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D 3273 for minimum of 4 weeks.

2.5 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Insulation Fasteners: Appropriate for purpose intended and approved by Factory Mutual and roofing manufacturer.

1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

C. Membrane and Insulation Adhesive: As recommended by roofing manufacturer and approved by Factory Mutual.

D. Roofing Nails: Galvanized, hot dipped type, size and configuration as required to suit application.

E. Termination Bars: As recommended by membrane manufacturer.

F. Sealants: As recommended by membrane manufacturer.

G. Spray Foam Insulation: As recommended by insulation manufacturer and roofing manufacturer.

H. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
1. Composition: Asphaltic with mineral granule surface.
2. Surface Color: White or yellow.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.2 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

F. Verify that positive roof slope exists in all areas.

G. Verify location, dimensions and elevations of primary and secondary roof drainage components including roof drains and overflow scuppers.

H. Correct unsuitable conditions before proceeding with installation. Commencing installation signifies acceptance by the installer of the substrate.

3.3 SUBSTRATE PREPARATION

A. Prior to the start of work, make the substrate smooth and free of debris, sharp edges, and other surface irregularities that will be detrimental to the installation.

B. Correct unevenness and joint gaps greater than 1/4 inch in the membrane substrate as they can cause inconsistent membrane welds. When such conditions occur fill with appropriate and properly secured insulation or material approved by manufacturer's technical review department.

C. Nailers: Verify that:
   1. Nailers are installed at gravel stops and drip edges.
   2. Nailers are pressure-preservative treated (fire-retardant-treated where required; creosote and asphaltic preservatives are not acceptable).
   3. Nailers are anchored with fasteners suitable for the application having a minimum withdrawal resistance of 100 lb, staggered 6 inches on center within 8 feet of an outside corners and 12 inches on center along other perimeter areas.
   4. Top surfaces of nailers match the top surface of adjacent construction plus/minus 1/4 inch, without contributing to ponding.

D. Flashing Substrates: Verify that the substrate is smooth and free of sharp edges and other surface irregularities that will be detrimental to 100-percent adhesion of the flashing membrane.

3.4 FASTENERS - GENERAL

A. Install fasteners with a depth-sensing screw gun to prevent overdriving or underdriving, unless otherwise approved or required by project conditions.

3.5 INSULATION - UNDER MEMBRANE

A. Attachment of Insulation:
   1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
   2. Exception: For Low Bay Warehouse area, mechanically fasten base layer of insulation and embed second layer and cover board in cold adhesive in accordance with roofing manufacturer's instructions and Factory Mutual requirements. "Walk-in" individual roof insulation boards to obtain maximum adhesive contact.
   3. Stagger layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.

B. Handle and secure insulation boards so as to not damage or rupture the facer and surface. Cut out damaged areas and replace with structurally sound insulation, properly secured in place.

C. Install boards with the longest dimension perpendicular to the direction of the membrane seams and with end joints staggered. Butt boards as closely as possible with no gaps over 1/4 inch.

D. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

E. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches from the clamp ring. Custom trim the lower edges immediately surrounding the drain bowl, and any hard edge between the flat panel and the tapered panel surface to provide a smooth, sloping transition. Miter corners of the tapered insulation panels with a 45 degree angle cut.

F. Fill gaps between boards and between boards and abutting vertical surfaces with spray-foam insulation.

G. Do not apply more insulation than can be covered with membrane in same day.

3.6 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Overlap edges and ends and seal seams by heat welding, minimum 4-1/2 inches. Seal permanently waterproof.
   1. Use hand-held welders for small work and repairs.
   2. Use automatic hot-air welders for field seaming.
   3. The equipment settings and alignment adjustments must be checked continuously during each day to insure complete fusion within the welded area and a smooth, wrinkle-free seam.
   4. The seams shall be checked for continuity and integrity. All imperfections shall be corrected.
   5. Caulk cut edges.

D. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

E. Fully Adhered: At Low Bay Warehouse area, install membrane adhered to the substrate, with edge securement as specified. Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.

F. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 8 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. On all curbs the flashing shall be bonded to the roofing membrane and turned up the curb and terminate beneath the curbs or mechanical equipment curb cap flashing.

G. Around roof penetrations, seal flanges and flashings with flexible flashing.

H. Roof Drains: Install in accordance with membrane manufacturer's details.
   1. Properly secure all bolts to provide 100-percent continuous compression of the clamping ring.
   2. Do not run field seams through drains.
   3. Insulation shall be tapered around the drain to provide positive drainage, prevent the membrane from bridging, and provide a smooth transition from the roof surface to the drain clamping ring.
   4. The seal between the membrane and the drain base shall be provided by polysulfide or polyurethane sealant under constant, even compression from the drain clamping ring.
   5. Where detailing drains, install a new target patch of PVC membrane, within the entire sumped profile. Cut a circular sheet opening of a diameter slightly greater than drain pipe diameter. Bolt holes within the new membrane shall be cut round only, no straight or cross cuts allowed.
   6. Cut membrane neatly to provide full acces to drain outlet pipe.

I. Metal Work:
   1. Install and anchor in a manner that prevents damage from buckling or wind, in accordance with SMACNA guidelines or in manner approved by membrane manufacturer.
   2. Seal and waterproof in an acceptable manner to prevent leakage.
   3. Make and install edge metal assemblies at perimeter in accordance with membrane manufacturer's details.

J. Roof Walkway Pads: Install pads in accordance with roofing manufacturer's instructions.
   1. Install walkway pads extending 4 feet from the service panels of all roof mounted equipment and at the roof access landing.
   2. Prepare dirty or weathered membrane, removing visible dirt and debris.
   3. Position walkway pad and cut to desired length.
   4. Whenever possible, do not cover membrane seams with walkway pad. When installed adjacent to a seam, keep the pad a minimum of 2 inches from the edge of the seam on the bottom sheet of the completed lap and a minimum of 6 inches from the edge of the

seam when located on the top sheet of a completed lap.

5. When covering seams is unavoidable, the lap seam should be completed per manufacturers recommendations, and thoroughly probed with any deficiencies repaired prior to pad installation.
6. In circumstances where drainage around the walkway pad is a concern, shorter walkway pad lengths spaced with a 2 inch gap may be desired.
7. Weld perimeter of walkway pad to the membrane following standard welding procedures. Periodic breaks in the weld of 1 to 2 inches are required on the low slope edge of the pad to prevent the accumulation of water under the pad.

3.7 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Ensure that metal work shall be secured in a manner approved by roof manufacturer, or in accordance with SMACNA guidelines, to prevent damage from buckling, or wind exposure. All metal work that is part of the waterproofing envelope shall be sealed, structurally sound, and appropriately anchored to prevent leakage.

C. Tests:
   1. Seam Tests: Probe the entire lap edge of each seam with an approved seam probing tool after seam has cooled completely to verify seam consistency. Probing before the seam area has cooled will damage the membrane.

D. Manufacturer's Field Service: Upon completion of the installation, have the manufacturer's representative make an inspection to ascertain that the roofing membrane system has been installed according to manufacturer's approved specifications and details.

E. Warranty Inspection: Provide copy of manufacturer's inspection for acceptance for warranty.

F. Rejection of Defective Work: Areas having excessive patching as a result of damage to the membrane or faulty installation may be rejected by membrane manufacturer or the Architect; replace the membrane completely in these areas.

3.8 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.9 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, downspouts, and conductor heads, and copings.

B. Project is a FM Global index project.

1.2 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers.

B. Section 07 5400 - Thermoplastic Membrane Roofing: Roofing system.

C. Section 07 9005 - Joint Sealers.

1.3 REFERENCE STANDARDS

A. ANSI/SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

C. Factory Mutual Data Sheet 1-49 Perimeter Flashing

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003, Sixth Edition.

1.4 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Submit manufacturer's full range of color options for Architect selection.

C. Warranty Specimen: For approval.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with Factory Mutual Data Sheet 1-49 Perimeter Flashing and SMACNA Architectural Sheet Metal Manual requirements, except as otherwise indicated.

B. Roof edge metal assemblies including copings, fascias and gravel stops shall be designed in accordance with ANSI/SPRI ES-1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warrant flashing and sheet metal work to be free of defects in materials and workmanship

for a period of two years from Date of Substantial Completion.

C. Roof edge metal assemblies shall be included in the roof system warranty. See Section 07 5400 - Thermoplastic Membrane Roofing.

D. Prefinished Metal: Warrant against fading and peeling for a period of 10 years.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 zinc coating; minimum.0239 inch (24 gage) thick base metal, shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; custom color to match approved sample.
   2. Underside shall be coated with manufacturer's standard wash coat.

2.2 FASTENERS:

A. Generally composed of same materials as flashings being fastened. Exposed fasteners shall have 5/8 inch steel/neoprene washers under the head. Fasteners shall be treated for resistance to rust and corrosion.
   1. Sheet Metal to Wood:
      a. Concealed Application: Annular threaded nail with minimum 3/16 inch diameter head, not less than 12 gauge and of sufficient length to penetrate substrate 1-1/4 inch minimum.
      b. Exposed Application: No. 10 screws minimum. Penetrate wood blocking minimum 1-1/2 inches. Installed withdrawal resistance shall be a minimum of 150 pounds per screw.
   2. Sheet Metal to Sheet Metal: Self-tapping sheet metal screws of 1/2 inch length and a minimum No. 8 diameter.
   3. Concrete and Masonry Anchors: Specially threaded anchors, 3/16 inch minimum diameter, length to penetrate minimum 1-1/2 inches into concrete or masonry. Installed withdrawal resistance shall be a minimum of 150 pounds per anchor.

2.3 FABRICATION

A. Shop fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.

B. Provide gage suitable for purpose as recommended by SMACNA Manual.

C. Form sections true to shape, accurate in size, square, and free from distortion or defects.

D. Form pieces in longest possible lengths.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Fabricate corners from one piece with minimum 4 inch nor more than 12 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

H. Blind clips and cleats shall be at least the same gauge as sheet metal flashing.

2.4 SCHEDULE

A. Downspouts:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 1-32B.

B. Downspout Hangers:
   1. Material: Galvanized steel, 20 gage.
   2. Design: SMACNA Figure 1-35A.

C. Gravel-Stop Fascia:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 2-1B.

D. Coping:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 3-4A; slope top 1/2 inch.
   3. Joint Design: SMACNA Figure 3-3, style 19; butt seam with 12 inch wide backup plate. Fabricate in 10 foot lengths with 1/2 inch minimum joint for expansion and contraction.

E. Conductor Heads:
   1. Material: Galvanized steel, 22 gage, soldered construction.
   2. Design: SMACNA Figure 1-25F.

F. Overflow Scupper:
   1. Material: Galvanized steel, 24 gage, soldered construction.
   2. Design: SMACNA Figure 1-30, modified in accordance with details indicated on Drawings.
   3. Fabricate scuppers with minimum 4" wide roof side flange. Cross section of scupper shall be ½" less in width and height than the parapet opening.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION

A. Except as otherwise indicated, comply with the installation recommendations of SMACNA and Factory Mutual Data Sheet 1-49 Perimeter Flashing.

B. Coordinate flashing at roof surfaces with roofing work to provide weather-tight condition at roof terminations.

C. Sheet metal items shall be installed true to line, without buckling, creasing, or warp.

D. Anchor units of work securely in place, providing for thermal expansion of metal units. Conceal fasteners where possible. Exposed fasteners shall be covered with sealant.

E. Fastening:
   1. Nails: Confine to one edge only of flashing 12" or less in width. Space nails at 4" o.c. maximum.
   2. Cleats: Continuous, formed to profile of item being secured.
   3. Clips: Minimum 2" wide by 3" long formed to profile of item being secured. Space at 24" o.c. maximum except as otherwise indicated.

F. Downspouts:
   1. Secure downspouts to exterior walls at 10 feet on center maximum. Lap downspout joints 1-1/2 inch and rivet.

2. Provide downspout terminations at grade. Coordinate installation to ensure that water is directed onto concrete paving or concrete splashblock. Provide connection to underground storm drain system where indicated on Drawings. Extend 2 inches into pvc cap, and apply sealant all around.

G. Roof Penetration Flashing: Flash and install penetrations in accordance with sheet roofing manufacturer's product data.

END OF SECTION

SECTION 07 7200

ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof hatches.

1.2 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.1 ROOF HATCHES

A. Manufacturers - Roof Hatches:
   1. Acudor Products Inc: www.acudor.com.
   2. Bilco Co.: www.bilco.com
   3. Dur-Red Products: www.dur-red.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. For Stair Access: Single leaf; 30 by 96 inches.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gage, 0.125 inch thick.
   2. Insulation: 1 inch rigid glass fiber, located on outside face of curb.
   3. Curb Height: 12 inches from finished surface of roof, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 0.125 inch thick, liner 0.04 inch thick.
   3. Insulation: 1 inch rigid glass fiber.
   4. Gasket: Neoprene, continuous around cover perimeter.

E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Locking: Padlock hasp on interior.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

B. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.

C. Adjust hinges for smooth operation.

END OF SECTION

SECTION 07 8400

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.
   1. Applications of firestop systems include:
      a. Penetrations for the passage of duct, cable, cable tray conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions).
      b. Gaps between the top of walls and ceilings or roof assemblies.
      c. Openings and penetrations in fire-rated partitions or walls containing fire doors.
      d. Openings around structural members, which penetrate floors or walls.

1.2 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 07 8100 - Applied Fireproofing.

C. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.3 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2011a.

B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.

C. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

D. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics. Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.

B. LEED Report: Submit VOC content documentation for all non-preformed materials.

1.5 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated and ASTM E 814, UL 1479 or UL 2079 .
   1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.

1.6 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 FIRESTOPPING - GENERAL REQUIREMENTS

A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.2 FIRESTOPPING, GENERAL

A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacture based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacture and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.3 ACCEPTABLE MANUFACTURERS

A. Firestopping assemblies listed are based upon use of Tremco Firestop Systems Products.

B. Other manufacturers assemblies may be utilized, subject to compliance with Through Penetration Firestop Systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory.

2.4 FIRESTOPPING SYSTEMS

A. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less:
   1. Minimum 4-1/2 inch thick Concrete Floors or Walls: UL Design No. C-AJ-1187, F Rating 2 hour.

B. Firestopping at Insulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less:
   1. Minimum 4-1/2 inch thick Concrete Floors or Walls: UL Design No. C-AJ-5121, F Rating 2 hour.

C. Firestopping at Combustible Plastic Pipe Penetrations, of diameter 4 inches or less: Any material meeting requirements.
   1. Minimum 4-1/2 inch thick Concrete Floors or Walls: UL Design No. C-AJ-2233, F Rating 2 hour.

D. Firestopping at Cable Penetrations, not in Conduit or Cable Tray:
   1. Minimum 4-1/2 inch thick Concrete Floors or Walls: UL Design No. C-AJ-3141, F Rating 2 hour.

E. Firestopping at Control Joints (without Penetrations):
   1. Between top of fire rated gypsum walls and bottom of fluted steel deck/concrete slab above: UL Design No. HW-D-0091, F Rating 2 hour.
   2. Joints in Interior Concrete or Block Walls: UL Design No. WW-S-0025, F Rating 2 hour.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authority having jurisdiction.

3.4 PROTECTION

A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9005

JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sealants and joint backing.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.07 - LEED Prohibited Content Installer Certification.

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 07 9216 - Interior Floor Joint Filler

D. Section 08 8000 - Glazing: Glazing sealants and accessories.

1.3 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2010.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.

D. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).

E. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; current edition.

F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating sealant performance criteria, substrate preparation, limitations, and color availability.

C. Color Samples:
   1. Submit samples of manufacturer's standard caulking material colors and special colors as indicated at least 30 days prior to commencement of application.
   2. Samples shall be actual materials. Owner reserves the right to reject work not in conformance with selected colors, based upon samples submitted.
   3. Should Contractor select a manufacturer meeting specified requirements, except for minimum color range requirements, he shall be responsible for furnishing special colors within color range requirements.

D. LEED Report: Submit VOC content documentation for all non-preformed sealants and primers.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.6 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.7 COORDINATION

A. Coordinate the work with all sections referencing this section.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a two year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
   1. Architectural sealants and primers used within the interior of the building shall have a maximum VOC limit of 250 g/l.

B. Exterior, Hot Applied Polymeric Joint Sealant: ASTM D 1190, AASHTO M 173.
   1. Product:
      a. W.R. Meadows: #1190
   2. Appplications: Use for sealing of cracks and joints in exterior concrete paving.

C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Color: Standard colors matching finished surfaces.
   2. Product:
      a. Pecora: AC-20 + Silicone.
      b. Sonneborn: Sonolac.
      c. Tremco: Tremflex 834
   3. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

D. Bathtub/Tile Sealant: Silicone; ASTM C 920, Uses I, M and A; single component, mildew resistant.
   1. Product:
      a. Pecora: #898.
      b. Sonneborn: OmniPlus.
      c. Tremco: Tremsil 200
   2. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bath countertops and wall surfaces.

E. Nonsag Polyurethane Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A, G; multi component, chemical curing, non-staining, non bleeding, non-sagging type.
   1. Color: Colors as selected by Architect from manufacturer's standard stock color selection.
   2. Product:
      a. Pecora: Dynatrol II.

b. Tremco: 240.
c. Sonneborn: Sonolastic NP 2.

3. Movement Capability: Plus and minus 50 percent.
4. Applications:
   a. Interior joints between concrete wall panels and between concrete panels and other work.

F. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Class 25, Uses T, M, A, O; multi- component, chemical curing, non staining, non bleeding, self-leveling type.
1. Color: Gray.
2. Product:
   a. Pecora: Urexpan NR 200.
   b. Sonneborn: Sonolastic SL 2.
   c. Vulkem: 245.
   d. Tremco: THC 900.
3. Movement Capability: Plus and minus 50 percent.
4. Applications:
   a. Joints in sidewalks and exterior concrete paving.
   b. Joint where concrete sidewalk or paving abuts vertical surfaces including walls and columns.
   c. Construction and control joints in interior concrete slabs and floors.

G. Silicone Sealant: ASTM C 920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, moisture curing, non staining, non bleeding.
1. Color: Color as selected by Architect from manufacturer's standard stock color selection.
2. Product:
   a. Dow Corning: #790.
   b. Pecora: #890.
   c. Tremco: Spectrem 1.
3. Movement Capability: Plus 100 percent, minus 50 percent.
4. Applications:
   a. Exterior and interior perimeter joints at storefronts.
   b. Bedding joints under exterior thresholds.
   c. Exterior joints between concrete wall panels and between concrete panels and other work.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces and joint openings are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Employ installation techniques which will insure that caulking materials are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and debris.

H. Do not allow materials to overflow or spill onto adjacent surfaces. use masking tape or other precautionary devices to prevent staining of adjacent surfaces.

I. Remove excess and misplaced materials as work progresses. Clean the adjoining surfaces to eliminate evidence of misplaced materials, without damage to adjacent surfaces or finishes.

J. Tool joints concave.

3.4 EXTERIOR CONCRETE WALL PANEL JOINTS

A. Coordinate installation of sealant and backer rod material with installation of textured coating. Backer rod may be placed in joint to prevent textured coating from adhering to joint surfaces.

B. Install panel joint sealant after textured coating has been applied.

3.5 CLEANING

A. Clean adjacent soiled surfaces.

3.6 PROTECTION

A. Protect sealants until cured.

END OF SECTION

SECTION 07 9216

INTERIOR FLOOR JOINT FILLER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing floor joint filler in construction joints and sawn control joints in interior concrete floor slabs within Warehouse Area.

1.2 RELATED SECTIONS

A. Section 03 3000 - Cast-In-Place Concrete.

B. Section 03 3513 - High Tolerance Concrete Floor Finishing.

C. Section 07 9005 - Joint Sealers.

1.3 REFERENCES

A. ASTM D 2240 - Rubber Property - Durometer Hardness.

B. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

1.4 SUBMITTALS

A. Product Data: Provide data indicating sealant performance criteria, substrate preparation, limitations and color availability.

B. Color Samples: Submit samples of manufacturer's standard material colors and special colors as indicated at least 30 days prior to commencement of application. Samples shall be actual materials.

C. Submit manufacturer's approved applicator certificate.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store materials in manufacturer's unopened packaging with seals and labels intact. Comply with manufacturer's instructions regarding environmental conditions under which materials may be stored.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the joint filler manufacturer during and after installation.

B. Comply with manufacturer's recommendation as to environmental conditions under which materials may be applied.

PART 2 PRODUCTS

2.1 SEMI-RIGID JOINT FILLER

A. Epoxy Products:

1. Metzger/McGuire Co: MM-80.
2. Euclid Chemical Co - Euco 700.

B. Description:
1. Hardness Shore A: A85 minimum.
2. Tensile Strength: 500 psi minimum.
3. Adhesion to Concrete: 285 psi minimum.
4. Solids Content: 100%.

C. Joint Filler Stain Preventing Film:
1. SPF by Metzger/McGuire.
2. Euco CleanCut by Euclid.

2.2 SELF-LEVELING FLEXIBLE POLYURETHANE JOINT FILLER

A. Products: Subject to compliance with requirements, provide one of the following:
1. Euclid Chemical Co: Eucolastic II.
2. Pecora: Urexpan NR 200.
3. Sonneborn Building Products - Sonolastic SL 2 Sealant.
4. Tremco: THC 900.
5. Vulkem - Vulkem 45.

B. Description:
1. Hardness - Shore "A": A30 minimum.
2. Movement Capability: Plus and minus 25 percent.
3. USDA Approved.

2.3 ACCESSORIES

A. Silica sand may be used at contractor's option to choke-off shrinkage cracks beneath filler. Silica must be dry, bagged, of 20 to 40 grit.

B. The use of compressible foam backer rod is strictly prohibited in ALL saw-cut control joints. Use of backer rod in any saw-cut joints will result in rejection of all saw-cut joint work.

C. Compressible foam backer rod may be used in through slab construction joints only but MUST be placed at a minimum depth of 2 inch. No other use of backer rod will be allowed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be by installer who is approved in writing by the manufacturer's corporate office for this project. It is the responsibility of the installer to inspect project and joint conditions and notify on-site management in writing of any deficiencies that might adversely affect the quality or durability of the work performed or his contract price. Start of work by the installer implies acceptance of conditions.

B. Installation shall not proceed until the slab has had a minimum cure time of 90 days.

C. Use joint filler stain preventing film at all joints where semi-rigid epoxy joint filler is applied.

3.2 JOINT SURFACE PREPARATION

A. Prior to installation of joint fillers, all saw-cut joints shall be thoroughly cleaned to their full original depth. Construction joints shall be cleaned to a minimum depth of 2 inch.

B. Construction joints shall be recut minimum 1/8 inch wide by 2 inch deep.

C. Where joints have minor raveling and edge chips (less than 1 inch wide), they shall be squared off and filled along with the joint itself.

D. Wide area surface spalled areas along the joint (1 inch wide and greater) shall be squared off and filled with epoxy repair mortar and joint recut and filled.

E. Apply stain preventing film prior to joint cleanout and filler placement.

3.3 CHOKING-OFF JOINT BOTTOM

A. The installer may, at his option, use a maximum of 1/4” of silica sand placed at the bottom of the saw-cut joints to prevent filler run-thru into the shrinkage crack.

B. Compressible backer rod is prohibited in saw-cut joints.

C. Compressible backer rod may be used in through-slab (non-sawn) construction joints only, but must be recessed at least 2” below the slab surface.

3.4 APPLICATION OF SEMI-RIGID JOINT FILLER

A. Material shall be mixed and installed in strict accordance with manufacturer's printed installation instructions, except where more stringent requirements are shown or specified.

B. Install using a two pass method per manufacturer instructions, with second pass overfilled (crowned).

C. Once the filler has fully cured, razor off excess to leave a flush filler profile. The overfill should be heated just prior to shaving to provide a smooth, flush filler profile (see manufacturer instructions on heating methods).

D. Remove stain preventing film. Film shall be removed by joint filler installer immediately after shaving joint filler.

3.5 APPLICATION OF FLEXIBLE POLYURETHANE JOINT FILLER

A. Material shall be mixed and installed in strict accordance with manufacturer's printed installation instructions, except where more stringent requirements are shown or specified.

B. Joint surfaces shall be primed as required by manufacturer to insure bonding.

C. Provide backer rod in joint at a uniform depth of 1/2 the joint width, with a minimum depth of 1/4 inch and a maximum depth of 1/2 inch. Take all necessary steps to prevent three sided adhesion.

D. Final cured profile shall be flush with the floor surface.

3.6 JOINT FILLER DEFICIENCIES

A. Installer is advised that significant deficiencies in workmanship, including less than proper filler depth, inadequate joint cleaning, concave filler profile, etc., shall be removed and properly replaced.

B. Joint filler installed to depths less than specified in this Section shall be removed and replaced at no additional cost to the General Contractor or Owner. As each sector of work is completed the general contractor, using a 1/8” drill bit, shall drill through the filler to verify filler depth. General Contractor shall test drill at an approximate rate of 1 core every 1,000 lineal feet. Location of core and filler depth found shall be recorded and provided to the owner prior to project completion.

3.7 JOINT FILLER SEPARATION:

A. Joint filler separation, both adhesive (leap-frog side to side) and cohesive, occurs as a result of concrete shrinkage and subsequent joint opening in excess of the fillers ability to laterally expand. In the event joint separation voids are 1/32 inch (credit card width) or greater, correction by refilling shall be required.

3.8 JOINT FILLER SCHEDULE

A. Interior Floor Slab Joints Subject to Movement: Flexible polyurethane joint sealant.
   1. Interior floor slab joints subject to movement include joints between floor slab and column isolation pour, and floor slab isolated from vertical wall surface.

B. Interior Warehouse Floor Slab Joints: Semi-rigid epoxy joint filler.
   1. Interior floor slab joints in non-office areas of Warehouse not subject to movement include sawn control joints and construction joints.

END OF SECTION

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated steel doors and frames.

B. Fire-rated steel doors and frames.

C. Thermally insulated steel doors.

D. Steel glazing frames.

1.2 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9000 - Painting and Coating: Field painting.

1.3 REFERENCE STANDARDS

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.

C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

E. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.

F. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).

G. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.

H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.

I. SDI - 105 - Recommended Erection Instructions for Steel Frames.

J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and

identifying location of different finishes, if any.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in accordance with NAAMM HMMA 840.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Steel Doors and Frames:
1. Ceco Door Products.
2. Curries Co.
3. Mesker Co.
4. Republic Builders Products.
5. Steelcraft.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.2 DOORS AND FRAMES

A. Requirements for All Doors and Frames:
1. Accessibility: Comply with ANSI/ICC A117.1.
2. Door Texture: Smooth faces.
3. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
4. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
5. Finish: Factory primed, for field finishing.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 STEEL DOORS

A. Exterior Doors:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18 gage). No visible seams permitted.
2. Core: Polystyrene foam.
3. Top Caps: Flush with top of faces and edges.
4. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
5. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
6. Weatherstripping: Separate, see Section 08 7100.

B. Interior Doors, Non-Fire-Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18 gage). No visible seams permitted.
2. Core: Polystyrene foam.
3. Thickness: 1-3/4 inches.

C. Interior Doors, Fire-Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18

gage). No visible seams permitted.
2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
   a. Provide units listed and labeled by Factory Mutual.
   b. Attach fire rating label to each fire rated unit.
3. Core: Honeycomb core, except that fire rated doors requiring temperature rise rating shall have mineral fiber core.
4. Thickness: 1-3/4 inches.

2.4 STEEL FRAMES

A. General:
   1. Comply with the requirements of grade specified for corresponding door.
      a. ANSI A250.8 Level 2 Doors: 16 gage frames.
   2. Finish: Same as for door.
   3. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

B. Exterior Door Frames: Face welded, seamless with joints filled.
   1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
   2. Weatherstripping: Separate, see Section 08 7100.

C. Interior Door Frames, Non-Fire-Rated: Face welded type.

D. Interior Door Frames, Fire-Rated: Face welded type.
   1. Fire Rating: Same as door, labeled.

E. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.5 ACCESSORY MATERIALS

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.

B. Glazing: As specified in Section 08 8000, factory installed.

C. Removable Stops: Formed sheet steel, mitered corners; prepared for countersink style tamper proof screws.

D. Astragals for Double Doors:
   1. Exterior Doors: Steel, Z-shaped.
   2. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.

E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.6 FINISH MATERIALS

A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

3.2 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

A. Install frames in accordance with SDI-105

B. In addition, install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Coordinate installation of hardware.

F. Coordinate installation of glazing.

G. Coordinate installation of electrical connections to electrical hardware items.

3.4 TOLERANCES

A. Clearances Between Door and Frame: As specified in ANSI A250.8.

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.5 ADJUSTING AND CLEANING

A. Adjust for smooth and balanced door movement.

B. Fill all dents, holes, etc. with metal filler and sand smooth and flush with adjacent surfaces - Paint to match finish.

C. Remove dirt and excess sealants, mortar, or glazing compounds from exposed surfaces.

END OF SECTION

SECTION 08 1416

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flush configuration; fire rated and non-rated.

1.2 RELATED REQUIREMENTS

A. Section 01 3516.02 - LEED Wood-Containing Product List

B. Section 08 1113 - Hollow Metal Doors and Frames.

C. Section 08 7100 - Door Hardware.

D. Section 08 8000 - Glazing.

1.3 REFERENCE STANDARDS

A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.

B. ICC (IBC) - International Building Code; 2012.

C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

D. Specimen warranty.

E. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special blocking for hardware, factory finishing criteria, identify cutouts for glazing and louvers.

F. Samples: Submit two samples of door veneer, 3 x3 inch in size illustrating wood grain, stain color, and sheen.

G. LEED Reports: Submit letter identifying harvesting and manufacturing location for wood material furnished under this section.
   1. Furnish Forest Stewardship Council (FSC) Chain-of-Custody certificate number for FSC wood permanently installed in project.
   2. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

H. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified

in this section with minimum three years of documented experience.

B. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on site to permit ventilation.

1.7 PROJECT CONDITIONS

A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Graham Wood Doors: www.grahamdoors.com.
   2. Eggers Industries; Product ____: www.eggersindustries.com.
   3. Marshfield DoorSystems, Inc: www.marshfielddoors.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 DOORS AND PANELS

A. All Doors: See drawings for locations and additional requirements.
   1. Quality Level: Custom Grade, in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1300.
   2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at all locations.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); Factory Mutual labeled.
   3. Wood veneer facing with factory transparent finish.

2.3 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.

B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

A. Wood Veneer Facing for Transparent Finish: White oak, veneer grade as specified by

quality standard, plain sliced, book veneer match, running assembly match.
1. Vertical Edges: Compatible hardwood.
2. Pairs: Pair match each pair; set match pairs within 10 feet of each other when doors are closed.

2.5 ACCESSORIES

A. Metal Louvers: Specified in Mechanical Section.

B. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style nails.

C. Astragals for Double Doors: Steel, T shaped, overlapping and recessed at face edge.

2.6 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.

D. Fit door edge trim to edge of stiles after applying veneer facing.

E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
1. Exception: Doors to be field finished.

G. Provide edge clearances in accordance with the quality standard specified.

2.7 FACTORY FINISHING - WOOD VENEER DOORS

A. Factory finish doors in accordance with specified quality standard:
1. Transparent Finish: Transparent catalyzed polyurethane, Custom quality, satin sheen.

B. Factory finish doors in accordance with approved sample.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).

D. Use machine tools to cut or drill for hardware.

E. Coordinate installation of doors with installation of frames and hardware.

F. Coordinate installation of glazing.

3.3 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 3613

SECTIONAL DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Overhead sectional doors, electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

1.2 RELATED REQUIREMENTS

A. Section 16XXX: Electrical service to disconnect located near door operator.

1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2010.

B. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).

C. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; Door & Access Systems Manufacturers' Association, International; 2004.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, hardware locations, and installation details.

C. Wind Load Certification: Submit documentation from manufacturer certifying that doors have been tested in accordance with the specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Doors shall include a manufacturer's label certifying compliance with specified windload.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals for warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 INSULATED STEEL SECTIONAL DOORS

A. Acceptable Manufacturers:
   1. Clopay: 3652 Series.
   2. Overhead Door Co: Thermacore 591 Series

3. Wayne Dalton Door Co: Thermospan TS150 Series.
4. Substitutions: See Section 01600 - Product Requirements.

B. Characteristics:
1. Size: As indicated on the drawings.
2. Type: Metal/foam/metal sandwich panel construction, with EPDM thermal break and ship-lap design with rounded water channels.
3. Panels:
   a. Metal Facer: Nominal 26 gauge galvanized steel, stucco embossed.
   b. Panel Thickness: nominal 1-1/2 inch.
   c. Finish: Manufacturer's standard baked-on polyester coat. Color to be white.
   d. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
   e. Thermal Values: Minimum R-value of 12.75.
4. Operation:
   a. Drive-In Doors: Electric motor operated.
5. Lift: Full vertical, unless otherwise indicated.
6. Hardware:
   a. Counterbalance: Heavy duty torsion springs mounted on cross header shaft. Minimum 25,000 cycle.
   b. Tracks: 3 inch.
   c. Provide lift handles on inside face.
   d. Lock: Provide inside only slide bar lock – mount at 5 feet AFFon left side of door.
   e. Hinges: heavy duty.
   f. Provide spring bumpers.
7. Weatherstripping: EPDM rubber tube seals fitted inside joints between sections. EPDM rubber bulb-type strip at bottom. Header seal and jamb weatherstripping.
8. Vision Panel: 1/2 inch insulated double strength glass. Nominal size 24 inch x 6 inch.
9. Wind Load Design: Withstand positive and negative wind loads when tested in accordance with ASTM E 330. Total test duration for each test direction shall be one minute at design pressure. Include pressure equal to 1.5 times the design pressure for 10 seconds during each test.
   a. Wind Load Pressure: +24 psf and -26 psf.

2.2 ELECTRICAL OPERATION

A. Electrical Characteristics:
1. 1/2 hp; manually operable in case of power failure, transit speed of 12 inches per second.
2. 115 volts, single phase, 60 Hz.

B. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.

C. Safety Edge: At bottom of door panel, full width; pneumatic sensitized type, wired to stop door upon striking object; hollow neoprene covered to provide weatherstrip seal.

D. Control Station: Standard three button (open-close-stop) momentary type control for each electric operator.
1. 24 volt circuit.
2. Surface mounted.
3. Locate at inside door jamb.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.

B. Maximum Variation from Level: 1/16 inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.4 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.5 PROTECTION

A. Protect installed products from damage during subsequent construction.

B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

SECTION 08 3616

HIGH IMPACT SECTIONAL DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Insulated, high-impact sectional overhead dock doors.

1.2 RELATED SECTIONS

A. Section 08 3613 - Sectional Doors.

1.3 SUBMITTALS

A. Product Data: Completely describing components and performance.

B. Shop Drawings: Showing details of fabrication, installation and accommodation to connecting work.

C. Wind Load Certification: Submit documentation from manufacturer certifying that doors have been tested in accordance with the specified requirements.

D. Installation Instructions: For door, optional operator and accessories.

E. Operating and Maintenance Data: For door, optional operator and accessories.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide each sectional overhead door as a complete unit produced by a single manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, and hardware.

B. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set, anchored or built into concrete or masonry; or drilled and tapped or welded to structural steel.

C. Installer Qualification: Door manufacturer or trained, approved and licensed door installer.

1.5 WARRANTY

A. Two-year warranty on entire door system against defects in material or workmanship.

PART 2 - PRODUCT

2.1 HIGH IMPACT OVERHEAD DOOR

A. Acceptable Manufacturer: Model TKO Welterweight as manufactured by TKO Doors. Contact Steve Burke, sburke@justriteequip.com, (215) 918-1030.
   1. Substitutions: See Section 01600 - Product Requirements.

2.2 DOOR SECTIONS

A. Door panels to be 2” thick unitized construction with exterior and interior panel skins firmly bonded to high density three pounds per square foot expanded polystyrene core insulation. Interior panel skin to be constructed of .09” high-impact polymer sheet for damage resistance. Exterior panel to be constructed of .015” aluminum with a crystal coat finish. Panels to be capped with co-extruded high-impact PVC edge capping containing UV inhibitors. Entire door panel to be colored white.
   1. Vision Panel: One 1/2” thermo pane IG tempered glass window unit mounted in molded

high-impact polymer frame. Window unit centered 52" - 62" from floor level.

2. Superpanel reinforcement consisting of a 1/16" acrylic-modified polyvinyl chloride sheet bolted to the interior panel surface and secured by panel frame for increased damage resistance on the bottom panel (white in color). Two-year performance warranty.

B. Wind Load Design: Withstand positive and negative wind loads when tested in accordance with ASTM E 330. Total test duration for each test direction shall be one minute at design pressure. Include pressure equal to 1.5 times the design pressure for 10 seconds during each test.
   1. Wind Load Pressure: +24 psf and -26 psf.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Provide manufacturer's standard track to be constructed of formed 12 gauge galvanized steel. Track design to be angled toward building exterior and wrap around hardware on the interior. This design to offer knockout capability towards exterior while still providing security. Door hardware to ride in channel. Tracks to be securely mounted flush with door jamb to maintain full opening width. Track systems that reduce door opening width will not be accepted.
   1. Full Height Impact-A-Track constructed of ultra high molecular weight polyethylene to prevent forklift impact damage.
      a. Supports: 8-gauge galvanized lower steel mounting angle to be factory installed to lower track. Upper mounting steel 8-gauge galvanized to be factory installed to upper track. Pre-punched slotted mounting holes on lower track mounting angles with upper track being supplied with necessary track mounting brackets to accommodate installation. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity without sag, sway and vibration during opening, closing and possible impact to door.

B. Weatherseal: Provide TPR (Thermo Plastic Rubber) bulb compression seal and 1.5" strip brush seal along both vertical edges of door panel. Provide one EPDM (Ethylene Propylene Diene Monomer) bottom bulb compression seal extending the full horizontal width of the door. Provide 2" horizontal brush seal to seal against uppermost door section when door is in closed position. Door-mounted weatherseal rises with the door, so there is no exposed seal in the doorway. Neither Non-compression weatherseals nor weatherseals attached to the door track or frame will be accepted.
   1. 3" bottom brush seal extending the width of the door to provide additional bottom seal.

C. Accessories:
   1. TKO slide bolt lock with padlock provision provides both internal and external security with the addition of padlock by others.
   2. TKO knockout lock for external security prevents door from being opened from the outside yet prevents damage to lock, door panel or track when impacted from the inside.

2.4 HARDWARE

A. General: Provide heavy-duty, rust-resistant hardware with galvanized, zinc-plated, cast aluminum or stainless steel to suit type of door.
   1. Hinges: High strength flat panel hinges constructed from 12-gauge steel attached to door panels with four bolts per hinge. Hinges to be connected with removable pin and clip for quick installation and removal of door panels. High tensile strength to allow cable attachment to upper door panels removing cables from impact zone.
   2. Plungers: Manufacturers standard spring loaded, round nosed, quick release plungers on knockout panels and fixed plungers on top panels. Plungers act as a quick release system when the door is impacted, preventing door panel damage. Plunger shafts to be 1/2" diameter steel shaft with 1/8" wall high-density polymer low-friction cap for total plunger diameter of 3/4". Plunger to be positioned in a stamped steel housing. All hardware to be zinc plated. Products using roller wheels or a shaft less than 5/8" in diameter will not be accepted.

2.5 COUNTERBALANCE

A. Torsion Spring: Operation by torsion-spring counterbalance consisting of adjustable-tension, tempered-steel torsion springs mounted on a cross header tubular steel shaft. Connect to door sections with galvanized 5/32" minimum diameter lift cables. Provide springs calibrated for 15,000-cycle minimum.

B. Provide cast-aluminum cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide minimum of one additional midpoint bracket(s) to support shafts.
   1. Solid 1" diameter keyed shaft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory.
   1. Verify precise opening size, dimensions, tolerances and obstructions.

3.2 PREPARATION

A. Protect surrounding areas and surfaces to prevent damage during work of this section.

B. Jobsite to comply with all OSHA regulations.

3.3 INSTALLATION

A. General: Install door, track and operating equipment complete with necessary hardware, anchors, inserts, hangers and equipment supports according to shop drawings, manufacturer's instructions and as specified.

B. Fasten track assembly to framing as specified in manufacturer's installation manual. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door opening equipment.

C. After completing installation, including work by other trades, test and adjust doors to operate easily, free from warp, twist or distortion, fitting weather-tight and knockout as detailed in manufacturer's standard performance specifications.

3.4 WARRANTIES

A. TKO Doors, A SPX Company, warrants that every door, its hardware and fittings will be free of defects in workmanship and material. Should any defect in workmanship or material appear within ONE (1) year of shipment, TKO shall, upon notification, correct such non-conformity at its option, by repairing or replacing any defective part or parts. This warranty does not include normal wear, modifications, and damage beyond the manufacturer's control, replacement labor or implied cycle life of counter balance systems [cables, spring assembly, drums, shaft cones, shaft bearings or center bearing bracket].
   1. Performance Warranty: door will remain operational after impact under normal use, service and maintenance for ONE (1) year (excluding any window portion thereof) from date of shipment. Does not cover punctures, cracks or slices in panel(s). [Optional Superpanel: two-year performance warranty from date of shipment].
   2. [OPTIONAL: Impact-A-Track™ in 3' sections] TKO Doors' warrant it's Impact-A-Track™ for FIVE (5) years from date of shipment. This is for the Impact-A-Track™ portion only. Cuts, gouges and abrasions are not considered warrantable conditions.

B. Except as expressly provided therein, TKO makes no warranties or representation, express or implied, with respect to the dock door including, without limitation, any warranty as to

merchantability or fitness for a particular purpose. In no event will TKO have liability to any person or entity for incidental or consequential damage of any description, whether arising out of warranty, negligence, tort or otherwise.

3.5 CLEANING

A. Leave the premises clean and free of residue of work of this section.

END OF SECTION

SECTION 08 4313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

D. Door hardware.

1.2 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Steel attachment devices.

B. Section 07 9005 - Joint Sealers: Perimeter sealant and back-up materials.

C. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

D. Section 08 8000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.

G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

H. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002 (Reapproved 2010).

I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.

B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.7 PROJECT CONDITIONS

A. Coordinate the work with installation of firestopping components or materials.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 ALUMINUM STOREFRONT FRAMING SYSTEM

A. Acceptable Manufacturers:
   1. EFCO Corporation.
   2. Kawneer Company.
   3. U.S. Aluminum.
   4. Vistawall.
   5. YKK Architectural Products.
   6. Substitutions: See Section 01600 - Product Requirements.

B. System: shall be equal to Series IT451 thermal break, as manufactured by US Aluminum.

2.2 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

1. Glazing Position: Front-set.
2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
3. Water Leakage Test Pressure Differential: 10 lbf/sq ft.
4. Air Infiltration Test Pressure Differential: 6.24 psf.
5. Finish: Class II natural anodized.

B. Performance Requirements:
   1. Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Design Wind Loads: 25lbf/sq foot, positive and negative.
      b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Provide steel reinforcement in mullions as required to meet wind load.
   3. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
   4. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
   5. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.
   6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.3 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Glazing stops: Flush.

B. Doors: Glazed aluminum, medium stile.
   1. Thickness: 1-3/4 inches.
   2. Top Rail: 3-1/2 inches wide.
   3. Vertical Stiles: 3-1/2 inches wide.
   4. Bottom Rail: 10 inches wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel. Exposed fasteners, countersunk, finish to match aluminum color.

D. Exposed Flashings:.050 inch thick aluminum sheet; finish to match framing members.

E. Concealed Flashings: 0.018 inch thick galvanized steel.

F. Perimeter Sealant: Type - Silicone, specified in Section 07 9005.

G. Glass: As specified in Section 08 8000.

H. Glazing Accessories: As specified in Section 08 8000.

2.5 FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.6 HARDWARE

A. Finish to match framing members unless indicated otherwise.

B. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.

C. Sill Sweep Strips: Resilient seal type, of neoprene; surface applied with concealed fasteners; provide on all exterior doors.

D. Threshold: Extruded mill finished aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

E. Pivots: Offset type; top, intermediate, and bottom.

F. Exit Devices: Touchbar concealed vertical rod.

G. Pull: 1 inch diameter tubular offset pull.

H. Closers: Heavy duty, concealed, without hold open.

I. Electric Strike: Compatible with dead latch, 24 volt. Provide on doors [where scheduled].

J. Cylinders: As specified in Section 08 7100 - Door Hardware.

2.7 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce components internally for door hardware.

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Set thresholds in bed of mastic and secure.

K. Install hardware using templates provided.

L. Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.

M. Install perimeter sealant in accordance with Section 07 9005.

N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.5 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION

SECTION 08 6200

UNIT SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preformed plastic skylights with integral metal frame and insulated metal curb.

1.2 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Miscellaneous steel framing for rough opening and burglar bars.

B. Section 07 5400 - Thermoplastic Membrane Roofing: Roofing system and base flashing at skylight curb.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. Aluminum Association (AA): Specifications for Aluminum Structures.

C. American Architectural Manufacturers Association (AAMA): 1605.1 Voluntary Standard Uniform Load Test Procedure for Plastic Glazed Skylights by Uniform Static Air Pressure Difference.

1.4 PERFORMANCE REQUIREMENTS

A. Design framing and dome infill to support the following load requirements:
   1. 10 PSF snow load plus dead load.
   2. 30 PSF negative wind or uplift load plus dead load.

B. Plastic unit skylights shall conform to recommendations of AA Specifications for Aluminum Structures and AAMA 1605.1 for dome lids.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide structural, thermal, and daylighting performance values.

C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace work which exhibits defects in materials or workmanship and guaranteeing weathertight and leak free performance. "Defects" is defined as uncontrolled leakage of water and abnormal aging or deterioration. Warranty period shall be 5 years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Unit Skylights:
   1. Oldcastle Building Envelope: E Series model SFEADD-5199.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 COMPONENTS

A. Unit Skylight: Factory-assembled glazing in aluminum frame; double dome.
   1. Inside Curb Opening: 48 x 96 inches.

B. Double Glazing: Acrylic plastic; factory sealed.
   1. Outer Glazing: White prismatic.
   2. Inner Glazing: Clear transparent.
   3. Maximum winter U-Value: 0.7.
   4. Maximum solar heat gain coefficient: 0.48.
   5. Minimum visible light transmittance: 70 percent.

C. Framing:
   1. Framing shall be multicellular design, comprised of an advanced engineered thermal polymer. Corners shall be fully welded around the entire profile and shall be air and watertight. No weep holes shall be required. System shall be designed for no collection of rainwater.
   2. Frames shall be white in color, aluminum retaining angle shall be mill finish.
   3. The curb shall consist of a single 0.062 inch extruded aluminum wall, 1" x 4" treated wood nailer and 3/4" thick polyisocyanurate insulation adhered to metal curb. Curbs shall be supplied with .062" extruded aluminum cap flashing and snap in place corner covers with foam corner plugs.
   4. Plastic glazing shall be permanently bonded to frame using a silicone adhesive for complete air and water tightness.
   5. Glazing shall be covered by an extruded aluminum angle designed to allow free release of rainwater back to the roof surface.

2.3 FABRICATION

A. Fabricate free of visual distortion and defects.

B. Fabricate to achieve leakproof, weathertight assembly.

C. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that openings and substrate conditions are ready to receive work of this section.

3.2 PREPARATION

A. Apply protective back coating on aluminum surfaces of skylight units that will be in contact with cementitious materials or dissimilar metals.

3.3 INSTALLATION

A. Install aluminum curb assembly, fastening securely to roof decking. Flash curb assembly into roof system.

B. Install extruded cap flashing into factory installed flashing cap receptacle. Snap in place aluminum corner covers to secure flashing assembly.

3.4 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces; wipe surfaces clean.

C. Remove excess sealant.

END OF SECTION

SECTION 08 7100

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood and hollow steel doors.

B. Hardware for fire-rated doors.

C. Electrically operated and controlled hardware.

D. Lock cylinders for doors for which hardware is specified in other sections.

E. Thresholds.

F. Weatherstripping, seals and door gaskets.

1.2 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 1416 - Flush Wood Doors.

C. Section 08 4313 - Aluminum-Framed Storefronts: Hardware for doors in storefront, including:
   1. Integral weatherstripping.
   2. Hinges.
   3. Exit devices.
   4. Closers.
   5. Push bars and pull handles.
   6. Thresholds.
   7. Installation of lock cylinders provided under this section.

1.3 REFERENCE STANDARDS

A. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.1).

B. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2008 (ANSI/BHMA A156.4).

C. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.6).

D. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.7).

E. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).

F. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).

G. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).

H. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2007 (ANSI/BHMA A156.31).

I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.

J. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.

1.5 SUBMITTALS

A. Hardware schedules: Schedule shall be in vertical format listing each door opening, including the handing of the opening, door sizes, materials of door and frames, any light or louver openings, degree of opening, all hardware scheduled for the opening and finish. Include cut/catalog sheets and any required special mounting instructions with the hardware schedule.

B. Certification of compliance: Submit any information necessary to indicate compliance to any or all of these specifications as requested.

C. Submit any samples necessary as required by architect.

D. Templates for finish hardware items shall be sent to related door and frame suppliers within 3 working days of approved schedule receipt.

1.6 QUALITY ASSURANCE

A. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with five years of experience.

B. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.8 COORDINATION

A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

B. Furnish templates for door and frame preparation.

C. Coordinate Owner's keying requirements during the course of the Work.

1.9 WARRANTY

A. All finish hardware shall be supplied with a one (1) year warranty against defects in materials and workmanship, commencing with the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 DOOR HARDWARE - GENERAL

A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.

B. Provide all items of a single type of the same model by the same manufacturer.

C. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.

2. Fire-Rated Doors: NFPA 80.
3. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.

D. Finishes: All door hardware the same finish unless otherwise indicated.
1. Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
2. Finish Definitions: BHMA A156.18.
3. Exceptions:
   a. Hinges for Exterior Doors: Satin stainless steel.
   b. Hinges for Fire-Rated Doors: Steel base metal with painted finish.

2.2 HINGES

A. Hinges: Provide hinges on every swinging door.
1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
2. Provide ball-bearing hinges at all doors having closers.
3. Provide hinges in the quantities indicated.
4. Provide non-removable pins with security studs on exterior outswinging doors.

B. Butt Hinges: Comply with BHMA A156.1 and A156.7; standard weight, unless otherwise indicated.
1. Provide hinge width required to clear surrounding trim.

C. Quantity of Hinges Per Door:
1. Doors up to 60 inches High: Two hinges.
2. Doors From 60 inches High up to 90 inches High: Three hinges.
3. Doors 90 inches High up to 120 inches High: Four hinges.

D. Manufacturers - Hinges:
1. Hager Companies: www.hagerco.com.
2. Stanley Black & Decker: www.stanleyblackanddecker.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.3 PUSH/PULLS:

A. Push/Pulls: Comply with BHMA A156.6.

B. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.

C. On solid doors, provide matching push plate and pull plate on opposite faces.

D. Acceptable Manufacturers:
1. H. B. Ives: 8103 Series Door Pull, and 8200 Series Push Plate.
2. Rockwood: #111 Door Pull, and #70 Push Plate.

E. Description:
1. Push Plate: Minimum .050 inch thick, 6 inch x 16 inch rectangular plate, with square corners.
2. Pull: Straight pull, 1 inch round, 10 inch center to center, with 2-1/2 inch projection.

2.4 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
1. Hardware Sets indicate locking functions required for each door.
2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
4. All locksets, latchsets, and trim shall be of one manufacturer and compatible with the IC cores specified.

5. Provide wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors. All cylinder collars shall be cast.

B. All locks and cylinders shall be compatible with Best Access System, 7-pin, small format, interchangeable core and keyed into a new factory-registered Grand Masterkey System with restricted keyway. Provide construction cores and keys during the construction period. Construction control and operating keys and cores shall not be part of the Owner's permanent keying system. All keying shall be accomplished at the factory of the lock manufacturer. Coordinate with Owner's representative to obtain keying requirements.

C. Supply keys in the following quantities:
   1. 5 master keys.
   2. 5 grand master keys.
   3. 3 change keys for each lock.

D. Keying: Grand master keyed.

2.5 CYLINDRICAL LOCKSETS

A. Manufacturers - Cylindrical Locksets:
   1. Assa Abloy Corbin Russwin: CL3600 Series, with "Newport" lever handle design.
   2. Best Access Systems, division of Stanley Security Solutions: 9K Series, with "15D" lever handle design.
   3. Sargent: 10 Line, with "L" lever handle design.
   4. Schlage: D Series, with "Sparta" lever handle design:
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.6 FLUSHBOLTS

A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
   1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
   2. Floor Bolts: Provide dustproof strike except at metal thresholds.

2.7 MAGNETIC LOCKS

A. Magnetic Locks:

B. Manufacturers:
   1. Assa Abloy Securitron: www.assaabloydss.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.8 ELECTRIC STRIKES

A. Electric Strikes: Complying with BHMA A156.31 and UL listed as a Burglary-Resistant Electric Door Strike; style to suit locks.

B. Manufacturers:
   1. Assa Abloy Folger Adam EDC, HES, or Securitron: www.assaabloydss.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.9 EXIT DEVICES

A. Acceptable Manufacturers:
   1. Corbin-Russwin: 39 Series.
   2. Dorma Group:
   3. Von Duprin: 99 Series.

B. Exit devices shall be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors shall be

thru-bolt mounted or per the door manufacturers listing requirements. All devices shall conform to N.F.P.A. #80 and #101 requirements.

C. All exit devices shall be of a heavy duty, chassis mounting design, with one piece removable covers, eliminating necessity of removing the device from the door for standard maintenance.

D. All trim shall be thru-bolted to the lock stile case.

E. All exit devices shall be of a brass, bronze, or stainless steel base material, plated to standard architectural finishes to match the balance of the door hardware. Painted or anodized aluminum finishes will not be considered acceptable for heavy duty usage on this project.

F. All exit devices shall be by the same manufacturer. No deviations will be considered.

2.10 ALARMED EXIT DEVICE

A. Acceptable Manufacturers:
   1. Precision: RALK
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Battery operated with a 9 volt battery with an audible low battery indicator.

C. Provide "emergency exit only" decal on touch bar device.

D. Provide exterior entrance pull with cylinder.

2.11 CLOSERS

A. Closers: Complying with BHMA A156.4.
   1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
   2. Provide a door closer on every exterior door.
   3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
   4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
   5. At outswinging exterior doors, mount closer in inside of door.

B. Manufacturers - Closers:
   1. Assa Abloy Norton or Sargent: www.assaabloydss.com.
   2. DORMA Group North America: www.dorma-usa.com/usa.
   3. LCN: www.lcnclosers.com.

C. All door closers shall be heavy duty, surface mounted, hydraulic type, with high strength cast case, full rack and pinion construction of heavy steel.

D. Size all closers in accordance with the manufacturers recommendations at the building site.

E. All closers shall be the products of a single manufacturer.

F. The closers shall have adjustable spring power, which allows for closer sizing. Closers shall have separate, tamper resistant, non critical regulating screw valves for closing speed, latching speed, and backcheck control as a standard feature.

2.12 STOPS AND HOLDERS

A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.

B. Acceptable Manufacturers:
   1. Glynn-Johnson:
      a. Interior Floor Mounted Door Stop: FB 13 (w/ riser as required)
      b. Exterior Floor Mounted Door Stop: FB 19X

c. Overhead Door Holder/Stop: 70H
2. H. B. Ives:
a. Interior Floor Mounted Door Stop: FS436 (w/ riser as required)
b. Exterior Floor Mounted Door Stop: FS442
3. Rockwood:
a. Interior Floor Mounted Door Stop: #441 (w/ riser as required)
b. Exterior Floor Mounted Door Stop: #483

C. Door stops shall be furnished for every door leaf. Every door shall have either a floor stop or overhead stop.

D. Place door stops in such a position that they permit maximum door swing, but do not present a hazard or obstruction. Furnish floor strikes on floor holders of proper height to engage holders or doors.

E. Where overhead stops and holders are specified, or otherwise required, they shall be heavy duty, and of solid brass or stainless steel with no plastic type or parts.

2.13 GASKETING AND THRESHOLDS

A. Gasketing:
1. Gaskets: Complying with BHMA A156.22.
a. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
b. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
1) Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
c. On each exterior door, provide door bottom sweep, unless otherwise indicated.
2. Acceptable Manufacturers:
a. National Guard Products:
1) Perimeter Seal: #160VA
2) Door Bottom Sweep: #C627A
b. Pemko Mfg
1) Perimeter Seal: #303AV
2) Door Bottom Sweep: #3452AV
c. Reese
1) Perimeter Seal: #128A
2) Door Bottom Sweep: #353A

B. Thresholds:
1. At each exterior door, provide a threshold unless otherwise indicated.
2. Accessible panic threshold, maximum overall height 1/2 inch. Threshold shall be extruded aluminum with mill finish and vinyl bumper gasket to seal against door. Provide width to fit door.
3. Acceptable Manufacturers:
a. National Guard Products: #896
b. Pemko Mfg: #2005AT
c. Reese: #F-S483APR

2.14 DRIP CAPS

A. Acceptable Manufacturers:
1. National Guard Products: #16
2. Pemko Mfg: #346
3. Reese: #R201A

2.15 LATCH GUARD

A. Acceptable Manufacturers:
   1. H. B. Ives: LG Series, coordinate with lockset type.
   2. Rockwood: 320 Series, coordinate with lockset type.

B. shall be stainless steel, without exposed fasteners on face of the unit.

2.16 PROTECTION PLATES

A. Protection Plates:
   1. Kickplate: Provide on push side of every door with closer, except storefront and all-glass doors.

B. Acceptable Manufacturers:
   1. Acceptable Manufacturers:
      a. H. B. Ives: LG Series, coordinate with lockset type.
      b. Rockwood: 320 Series, coordinate with lockset type.

C. Kickplates shall be 8" high by 2" less than door width and mounted flush with the bottom of the door. They shall be 16 gauge (.050) thick stainless steel. For doors with louvers, or narrow bottom rails; kickplate height shall be 1" less than the dimension shown from the bottom of the door to the bottom of the louver or glass.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.

D. Hardware shall be completely fitted before the final coat of paint or other finish is applied, and then removed for the final coat. Mortise and cutting shall be done neatly, and evidence of cutting shall be concealed in the finished work. Permanently install the hardware after finishing operations are complete and dry.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.

3.4 PROTECTION

A. Do not permit adjacent work to damage hardware or finish.

B. Protect knobs/levers from scratching or other damage. Tag keys and turn over to the owner at the time of acceptance of the project.

END OF SECTION

SECTION 08 8000

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass.

B. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

A. Section 07 9005 - Joint Sealers: Sealant and back-up material.

B. Section 08 1113 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites.

C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

D. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished by storefront manufacturer.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.

D. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.

E. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2012.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2011a.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

I. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2009.

J. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.

1.4 PERFORMANCE REQUIREMENTS

A. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures in accordance with the International Building Code.
   1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
   2. Limit glass deflection to 1/175 or 3/4 inch or flexure limit of glass, whichever is less, with full recovery of glazing materials.
   3. Thicknesses listed are minimum.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Samples: Submit two samples 12 x 12 inch in size of glass units, showing coloration and design.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.7 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.1 GLAZING TYPES

A. Type IG-1 - Sealed Insulating Glass Units: Vision glazing, low-E.
   1. Application(s): All exterior glazing unless otherwise indicated.
   2. Between-lite space filled with air.
   3. Thermal Resistance (U-Value): 0.29, nominal.
   4. Total Solar Heat Gain Coefficient: 0.29, nominal.
   5. Total Visible Light Transmittance: 34 percent to 37 percent.
   6. Basis of Design: PPG Industries, Inc: www.ppgideascapes.com.
   7. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Low E Coating: PPG Solarban 60 on # 2 surface, no coating on #3 surface.
      b. Tint: Solargray.
   8. Inboard Lite: Annealed float glass, 1/4 inch thick.
      a. Tint: None (clear).
   9. Total Thickness: 1 inch.

2.2 GLASS MATERIALS

A. Float Glass: All glazing is to be float glass unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048.
   3. Tinted Types: Color and performance characteristics as indicated.
   4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.

2.3 SEALED INSULATING LAMINATED GLASS MATERIALS

A. Sealed Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Edge Spacers: Aluminum, bent and soldered corners.
   3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
   4. Purge interpane space with dry hermetic air.

2.4 UNFRAMED MIRROR

A. 6 mm (1/4 inch) minimum thickness, mirror glazing quality plate or float glass with silver

coating and electrolitically copper plated back. Grind and polish all edges.

2.5 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; moisture curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 100/50, cured Shore A hardness of 15 to 25; color as selected.

2.6 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness;black color.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option II; black color.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Prime surfaces scheduled to receive sealant.

C. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.

D. Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

A. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Wash all glass prior to Date of Substantial Completion using a mild detergent or glass cleaner, leaving glass clean and free of streaks.

3.5 PROTECTION

A. Remove and replace broken, cracked, chipped or otherwise damaged glazing materials prior to Date of Substantial Completion.

END OF SECTION

SECTION 08 8005

INSULATED METAL GLAZING PANELS

PART 1 GENERAL

1.1 SCOPE

A. Insulated metal glazing panels. Panels are designed to be glazed into a window system or curtain wall system.

1.2 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of 10 years experience in the manufacturing of this type of panel.

B. Provide all architectural panels from a single source.

C. Field measurements shall be taken prior to the manufacturing and or cutting.

1.3 SUBMITTALS

A. Manufacture's Product Data sheets.
   1. Submit three (3) each, samples 6” x 6”

1.4 WARRANTY

A. Provide manufacturer's standard limited warranty document executed by an authorized company official.

B. Panel manufacturer shall warrant the panels, it supplies will be free from defects in material and workmanship for a period of two (2) years from substantial completion.

C. Panel manufacturer shall warrant that the painted finish will not chalk, crack or peel for a period of twenty (20) years from substantial completion.

1.5 PRODUCT DELIVERY, STORAGE & HANDLING

A. Materials will be delivered to the site in an undamaged condition. Use care in handling and hoisting of panels during transportation and at jobsite. All panels and component parts to be stored above grade, on pallets or blocking, out of contact with the ground under protective covers, inside the building, or in storage trailers, so as to prevent damage, warping, bending, or condensation from forming between the panels.

B. Prefinished panel exteriors shall be protected with strippable vinyl masking during manufacture, delivery, storage, and installation. Follow manufacturer's recommended instructions for the removal of the masking.

C. All damaged panels shall be removed from the site and replaced with new panels at no additional cost to the owner. All materials shall be new and of the best quality. Materials shall be delivered and stored on site in sufficient quantities to allow for the continuity of the work.

D. All materials shall be protected at all times from damage of all kinds, including scratches, dents, stains, and deformation. No damaged materials shall be incorporated into any of the work. Protection during installation shall be the responsibility of the contractor.

PART 2- PRODUCTS

2.1 MANUFACTURER

A. Columbia Architectural Products, Inc.: Alclad.
   1. Substitutions in accordance with Section 01 6000.

2.2 INSULATED METAL GLAZING PANELS

A. Panels are to be 1" nominal thickness.
   1. Face: .032 aluminum smooth.
   2. Finish: Custom red color.
   3. Substrate: 1/8" hardboard.
   4. Core: expanded polystyrene (EPS) foam board.
   5. Back: .032 aluminum smooth.

2.3 FABRICATION

A. Panels are to be produced in a controlled environment using state of the art automated laminating equipment. Heated adhesive applied to each surface by a an automated reciprocal spray system assuring an even coverage to the exact thickness required for proper adhesion of all parts. Minimum 100 lb. pressure evenly applied with an automated rotary pinch roller to assure a high strength bond.

2.4 ACCESSORIES

A. Moldings, angles or stops as required providing a weather tight installation.

B. Sealants as recommended for use as an infill panel component.

2.5 FINISHES

A. Exposed aluminum surfaces: All exposed surfaces of insulated metal glazing panels shall be finished with Polyvinyl-fluoride system meeting "Kynar 500." Duranar Fluoropolymer or equal manufacturer's standard 2-coat thermo-cured system composed of specially formulated inhibitive primer, fluorocarbon color coat with a dry film thickness not less than 1.5 mils, and conforming to AAMA 605.2. Exposed surfaces shall be clean of oils, dirt, and free of blemishes. Color shall be selected by Owner from manufacturer's standard colors. Unless otherwise noted. The back face shall have either mill finish or of random finish material.

PART 3 EXECUTION

3.1 PREPARATION AND INSPECTION

A. Verify existing wall opening conditions to determine that all conditions required for installation of panels are within tolerances acceptable and are ready to receive the work of this section.

3.2 INSTALLATION

A. The installation contractor and his representatives shall be totally responsible for the installation of the complete panel system.

B. Use only skilled tradesmen and complete all work in strict accordance with the manufacturer's specifications and recommendations for the installation of the panels and associated components as well as the approved project shop drawings and these specifications.

C. All panels shall be installed with setting blocks in a fixed glazed window system as indicated on shop drawings. Install panels and other components securely in place, with provisions for thermal and structural movement.

D. Exposed surfaces shall be kept clean and free from sealants, metal cuttings, hazardous burrs, and any other foreign materials. Stained, discolored, or damaged panels shall be

removed from the site.

E. Perform all glazing operations to completely seal metal to metal contact surfaces. Use sealants as recommended for use as an infill panel component.

3.3 ADJUSTMENTS, PROTECTION, AND CLEANING

A. Clean aluminum surfaces promptly after installation of panels in accordance with the manufacturer's instructions. Exercise extreme caution to avoid damage to finish. Do not use abrasives, caustic, or acid cleaning agents in cleaning surfaces of panels. Thoroughly clean all surfaces of any excess sealant prior to sealant curing, compounds, dirt, handling marks, or other substances by using cleaning agents acceptable to the panel manufacturer. Touch up all scratches, abrasion, blemishes, and other defects in the prefinished metal surface with factory supplied finish materials.

B. Initiate all protection and other precautions required to ensure that panels will be without damage or deterioration (other than normal weathering) at time of acceptance. Send copy of written recommendations for maintenance and protection of panels to the Owner at close-out.

END OF SECTION

SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acoustic insulation.

B. Gypsum sheathing.

C. Cementitious backing board.

D. Gypsum wallboard.

E. Decorative moldings and reveals.

F. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 2100 - Thermal Insulation: Thermal insulation.

C. Section 09 2216 - Non-Structural Metal Framing.

D. Section 09 9720 - Direct Applied Exterior Finish System.

1.3 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2011.

B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2011.

E. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2010a.

F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2008.

G. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing; 2012.

H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2011.

I. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2010.

1.4 SUBMITTALS

A. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

1.5 QUALITY ASSURANCE

A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

B. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.2 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
   4. Paper-Faced Products:
      a. USG Corporation; Sheetrock Brand Gypsum Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Mold Resistant Wallboard: Moisture and mold-resistant gypsum core encased in moisture resistant papers.
   1. Application: At all interior surfaces of exterior walls.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness: 5/8 inch.
   4. Products:
      a. USG Corporation: Sheetrock Brand HUMITEK Gypsum Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thin-set walls, restroom walls, and janitor room walls.
   2. Type: Regular and Type X, in locations indicated.
   3. Type X Thickness: 5/8 inch.
   4. Regular Board Thickness: 5/8 inch.
   5. Edges: Tapered.
   6. Products:
      a. USG Corporation; Fiberock Aqua-Tough Interior Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 1/2 inch.
   3. Edges: Tapered.
   4. Products:
      a. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing at ceilings, unless otherwise indicated.
   2. Glass-Mat-Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.

3. Regular Board Thickness: 1/2 inch.
4. Edges: V-shaped tongue and groove, for horizontal application.
5. Glass-Mat-Faced Products:
   a. CertainTeed Corporation; GlasRoc Brand.
   b. Georgia-Pacific Gypsum; DensGlass Sheathing.
   c. National Gypsum Company; Gold Bond Brand e2XP Extended Exposure Sheathing.

2.3 ACCESSORIES

A. Moldings and Reveals: Extruded aluminum drywall trim. Size and shape as indicated on the drawings.

B. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
   1. Knauf Insulation: Quiet Therm Sound Attenuation Batts.

C. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

D. Water-Resistive Barrier: As specified in Section 07 2500.

E. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.

F. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
   2. Ready-mixed vinyl-based joint compound.

G. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

H. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.

I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

J. Exterior Soffit Vents: One piece, perforated, solid vinyl, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide ventilation area shown on drawings..

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

3.3 BOARD INSTALLATION

A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board vertical (parallel to framing), with ends and edges occurring over firm bearing.
   1. Stagger joints in drywall on opposite sides of metal studs.

C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing horizontally, with edges butted tight and ends occurring over firm bearing.

E. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of all gypsum board.

G. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations shown on the drawings. Provide vent area shown on drawings.

E. Moldings and Reveals: Install in accordance with manufacturer's instructions. All pieces shall be securely mounted to gypsum wallboard substrate and all joints shall be butted tight and finished smooth.

3.5 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.

B. Paper Faced Gypsum Board: Use fiberglass joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
   4. Level 0: Temporary partitions and surfaces indicated to be finished in later stage of project.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.6 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Framing accessories.

1.2 RELATED REQUIREMENTS

A. Section 08 3100 - Access Doors and Panels.

B. Section 09 2116 - Gypsum Board Assemblies.

1.3 REFERENCE STANDARDS

A. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.

B. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.1 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf at interior and L/360 at 20 psf for exterior locations.
   1. Studs: C shaped with flat or formed webs.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Partition Head to Structure Connections: Provide extended leg track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short.

C. Tracks and Runners: Same material and thickness as studs or heavier per design requirements, bent leg retainer notched to receive studs.

D. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.

E. Fasteners: ASTM C1002 self-piercing tapping screws.

F. Anchorage Devices: Power actuated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

3.2 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.

D. Align and secure top and bottom runners at 24 inches on center.

E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

F. Install studs vertically at spacing indicated on drawings.

G. Align stud web openings horizontally.

H. Secure studs to tracks using fastener method. Do not weld.

I. Fabricate corners using a minimum of three studs.

J. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.

K. Brace stud framing system rigid.

L. Coordinate erection of studs with requirements of door frames; install supports and attachments.

M. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

3.3 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

E. Space main carrying channels at maximum 48 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

END OF SECTION

SECTION 09 3000

TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Stone thresholds.

D. Ceramic trim.

E. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

A. Section 07 9005 - Joint Sealers.

B. Section 09 2116 - Gypsum Board Assemblies: Installation of tile backer board.

1.3 REFERENCE STANDARDS

A. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2012.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 12 x 12 inches in size illustrating pattern, color variations, and grout joint size variations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

1.6 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.7 EXTRA MATERIALS

A. Provide 2 percent of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.1 TILE

A. Manufacturers:
   1. Dal-Tile: www.daltile.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Ceramic Mosaic Tile:
   1. Moisture Absorption: 0 to 0.5 percent.
   2. Size and Shape: Random mosaic blend.
   3. Edges: Square.
   4. Surface Finish: Matte glazed.
   5. Colors: As scheduled.

C. Glazed Wall Tile:
   1. Moisture Absorption: 3.0 to 7.0 percent.
   2. Size and Shape: 3 x 6 inch.
   3. Edges: Cushioned.
   4. Colors: As scheduled.
   5. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.

D. Porcelain Tile:
   1. Moisture Absorption: 0 to 0.5 percent.
   2. Size and Shape: 18 inch square.
   3. Thickness: 3/8 inch
   4. Edges: Cushioned.
   5. Surface Finish: Matte finish..
   6. Colors: As scheduled.
   7. Trim Units: Matching bullnose shapes in sizes coordinated with field tile.

2.2 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose and cove base ceramic shapes in sizes coordinated with field tile.
   1. Applications: Use in the following locations:
      a. Open Edges: Bullnose.
      b. Inside Corners: Jointed.
      c. Floor to Wall Joints: Cove base.
   2. Manufacturer: Same as for tile.

B. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications: Use in the following locations:
      a. Transition between floor finishes of different heights.
      b. Borders and other trim as indicated on drawings.

C. Thresholds: Marble, white, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
   1. Applications: Provide at the following locations:
      a. At doorways where tile terminates.

2.3 SETTING MATERIALS

2.4 MORTAR MATERIALS

A. Mortar Bond Coat Materials for Thin-Set Installations:
   1. Latex-Portland Cement type: ANSI A118.4.

2.5 GROUTS

A. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated.
   2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
   3. Color(s): As selected by Architect from manufacturer's full line.

4. Products:
   a. Custom Building Products; Prism SureColor Grout: www.custombuildingproducts.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.6 THIN-SET ACCESSORY MATERIALS

A. Waterproofing Membrane at Floors: PVC sheet membrane, 40 mils thick, minimum; specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Products:
      a. Custom Building Products; RedGard Waterproofing & Crack Prevention Membrane, with fiberglass mesh reinforcement at changes of plane and gaps: www.custombuildingproducts.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install elastomeric membrane over control joints in floor slab in accordance with manufacturer's instructions.

3.3 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and The Tile Council of North America Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints. Use standard grout unless otherwise indicated.

L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-portland cement bond coat, with standard grout, unless otherwise indicated.

3.5 INSTALLATION - WALL TILE

A. Over gypsum wallboard on wood or metal studs install in accordance with The Tile Council of North America Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise indicated.

B. Over interior concrete and masonry install in accordance with The Tile Council of North America Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 5100

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 REFERENCE STANDARDS

A. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2007.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2008.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2011.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples 6 x 6 inch in size illustrating material and finish of acoustical units.

D. LEED Submittal: Documentation of recycled content and location of manufacture.

1.4 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.5 PROJECT CONDITIONS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Install acoustical units after interior wet work is dry.

1.6 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Provide 80 sq ft of each type of acoustical unit for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels:.
   1. Size: 24 x 24 inches.
   2. Panel Edge: tegular.
   3. Surface Pattern: Non-directional, fissured.
   4. Surface Color: White.
   5. Product: Equal to #1732 "Fine Fissured" by Armstrong.

2.2 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: ASTM C635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
   1. Hold Down Clips: Suspension system manufacturer's standard design compatible with ceiling panels specified and fire rating as required.
   2. Hanger Wire: Minimum 12 gauge, galvanized, soft annealed, mild steel wire.
   3. Hanger Rod: Minimum 1/4" diameter, threaded galvanized steel rod.
   4. Hanger Strap: Minimum 3/16" thickness by 1" wide, galvanized steel strap for fixture support.
   5. Wire Ties: Minimum 18 gauge, galvanized, annealed steel wire.
   6. Hanger Clips: Prefabricated metal clamps for fastening to building structure.
   7. Carrying Channels: 16 gauge, cold-rolled steel, 1-1/2" deep.

B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; intermediate-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White painted.

2.3 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.1 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

3.2 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

G. Install hold-down clips on panels within 10 ft of an exterior door.

3.3 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 6500

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.2 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.3 REFERENCE STANDARDS

A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2010)e1.

B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008.

1.4 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

D. LEED Report: Report recycled content and VOC emission of flooring; VOC content of adhesives.

1.5 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness, and:
   1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   2. Size: 12 x 12 inch.
   3. Thickness: 0.125 inch.
   4. Pattern: As scheduled.
   5. Manufacturers:

a. Armstrong World Industries, Inc: www.armstrong.com.
b. Substitutions: See Section 01 6000 - Product Requirements.

B. Vinyl Planks: Printed film solid vinyl plank.
1. Minimum Requirements: Comply with ASTTM-F 1700, Class III.
2. Size: 4 x 36 inch.
3. Thickness: .098"
4. Patern: As scheduled.
5. Manufacturers:
a. Patcraft
b. Substitutions: See Section 01 6000 - Product Requirements.

2.2 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
1. Height: 4 inch.
2. Thickness: 0.125 inch thick.
3. Finish: Satin.
4. Color: Color as selected from manufacturer's standards.
5. Accessories: Premolded external corners and end stops.
6. Manufacturers:
a. Burke Flooring: www.burkemercer.com.
b. Johnsonite, Inc: www.johnsonite.com.
c. Roppe Corp: www.roppe.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.3 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Metal.

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

C. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is cured.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

3.5 RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.6 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's instructions.

3.7 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 6813

TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, loose laid with edges and control grid adhered with polyester backed adhesive squares.

B. Removal of existing carpet tile.

1.2 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2010e1.

B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.

C. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.

D. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute; Current Edition.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2011.

1.3 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

C. LEED Report: Submit data documenting VOC content of carpet tile and adhesives; copy of current CRI Approved Products Listing is acceptable.

1.4 FIELD CONDITIONS

1.5 EXTRA MATERIALS

A. Provide two boxes of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.1 MATERIALS

A. Carpet Tile: Tufted, manufactured in one color dye lot.
   1. Product: As scheduled on Drawings, manufactured by Shaw Contract.
   2. Tile Size: 24 x 24 inch, nominal.
   3. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   4. VOC Content: Provide CRI Green Label Plus certified product.
   5. Primary Backing Material: GlasBac Tile.

2.2 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Rubber, color as selected.

C. Adhesive Strips: TacTiles by Interface. Compounded acrylic adhesive, applied to PET polyester backing with PET polyester release liner. Dimension of 3 x 3 inch squares.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

3.2 PREPARATION

A. Remove existing carpet tile.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.

D. Blend carpet from different cartons to ensure minimal variation in color match.

E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

G. Locate change of color or pattern between rooms under door centerline.

H. TacTiles shall be used to secure tile to floor. Place tactile under each corner of tile as recommended by the manufacturer.

I. Trim carpet tile neatly at walls and around interruptions.

J. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 6900

ACCESS FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor supported bolted stringer understructure.

B. Removable floor panels.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of access floor system to building grounding system.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

B. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

C. NFPA 75 - Standard for the Protection of Information Technology Equipment; National Fire Protection Association; 2013.

1.4 PERFORMANCE REQUIREMENTS

A. Pedestals:
   1. Maximum Axial Load: 2,500 lb without permanent deformation.

B. Floor Panels: Conform to the following:
   1. Stringer Concentrated Load: 450 lb on 1 sq in at midspan with maximum deflection of 0.100 inch.
   2. Permanent Deformation: 0.010 inch maximum at design load.
   3. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/10, maximum, when tested in accordance with ASTM E 84.

C. Lateral Stability: Design system for lateral stability in all directions, with or without panels in place.

1.5 DESIGN REQUIREMENTS

A. System: Bolted stringer understructure.

B. Access flooring system to achieve finished floor elevation 12 inches nominal height above building structural floor.

C. Floor Panel Size: 24 x 24 inches.

1.6 SUBMITTALS

A. Product Data: Provide data for grid system, panels, and accessories; electrical resistance characteristics and ground connection requirements.

B. Shop Drawings: Indicate floor layout, interruptions to grid, special sized panels, panels requiring drilling or cut-out for services, appurtenances or interruptions, edge details, elevation differences, ramps, grilles, and registers.

C. Samples: Submit two samples of floor grid and panel, 12x12 inch in size illustrating finishes and color.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

F. LEED Submittal: Documentation of recycled content and location of manufacture.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work required in this section, with minimum three years of experience.

1.8 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.

1.9 EXTRA MATERIALS

A. Provide four of each size of floor panel.

B. Provide four spare pedestals and four stringers.

C. Panel Lifting Devices: Two, of manufacturer's standard type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Access Flooring:
   1. Tate Access Floors, Inc; Product 1250: www.tateaccessfloors.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ACCESS FLOORING

A. Access Flooring: Factory-fabricated system consisting of removable floor panels and supporting structure that allows access to each space below floor without requiring removal of panels other than the one directly above the space to which access is needed; provide all components and accessories required for complete installation and as indicated.
   1. Comply with applicable codes for access for the handicapped.
   2. Finished Floor Elevation: Top of access floor 12 inches nominal height above building structural floor.
   3. Floor Panel Size: 24 x 24 inches.

B. Performance Requirements:
   1. Pedestals:
      a. Maximum Axial Load: 2,000 lb without permanent deformation.
      b. Ultimate Strength: Not less than twice design load.
   2. Floor Panels: Conform to the following:
      a. Live Load: 250 lb/sq ft.
      b. Maximum Deflection: 0.04 inch.
      c. Concentrated Load: 1,000 lb on 1 sq in at any location with maximum deflection of 0.08 inch.
      d. Permanent Deformation: 0.02 inch maximum at design load.
      e. Ultimate Strength: Not less than twice design load.
      f. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke

developed index of 450, maximum; when tested in accordance with ASTM E84.

3. Lateral Stability: Design system for lateral stability in all directions, with or without panels in place.
4. Surface Electrical Resistance: Maximum 1 ohm per panel.

2.3 COMPONENTS

A. Pedestals: Steel with flat bottom base plate, threaded supporting rod, vibration proof lock nut to permit 1-1/2 inch adjustment, galvanized finish.

B. Frame Grid Stringers: Continuous type, consisting of steel channels, box, or tee sections.

C. Floor Panels: Shall consist of a top steel sheet welded to a formed steel bottom pan filled internally by a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.
   1. Floor panels shall be protected from corrosion by electro-deposited epoxy paint. The use of zinc electroplating shall be prohibited.
   2. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: This greatly reduces the potential for dust in the environment from exposed cement materials.
   3. Steel Airflow Panels: Perforated steel airflow panels designed for static loads shall be interchangeable with standard ConCore 2500 field panels and shall be capable of supporting a concentrated load of 800 lbs. All panels shall have 25% open surface area

2.4 ACCESSORIES

A. Ramps and Stairs: Same materials, structural strength, and construction as floor panels; flush extruded aluminum cover plates at junction with floor system.

B. Ramp and Stair Hand Railings: Posts and rails of tubular; assembled with welded connections; cast metal end caps, floor sockets, collars, brackets, and fittings.

C. Cable Cutout Protection: Extruded polyvinyl chloride edging, self-extinguishing.

D. Gaskets: Closed cell sponge rubber, preformed to suit.

2.5 FINISHES

A. Floor Panel Finish:
   1. Melamine phenolic laminate, NEMA LD3, HWH - 0.118 inch nominal thickness; gray color with black edge trim.

B. High-pressure laminate floor coverings shall have an edge condition that is integral to the tile. Separate edge trim pieces are not acceptable.

2.6 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Floor Panel Flatness: Plus or minus 0.035 inch in any direction.
   2. Floor Panel Width or Length From Specified Size: Plus or minus 0.010 inch.
   3. Floor Panel Squareness: Plus or minus 0.015 inch difference between opposite diagonal dimensions.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine structural subfloor for unevenness, irregularities and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum clean subfloor to remove dust, dirt, and construction debris before beginning installation.

C. Area to receive access floor shall be enclosed and be maintained at a temperature range of 35° to 95° F and a humidity range of 20% to 80% relative. All laminated floor panels shall be stored and maintained in this environment upon delivery to storage sites. Bare access floor panels must be stored in this environment at least 24 hours before installation begins.

3.2 INSTALLATION

A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.

B. Install components in accordance with manufacturer's instructions.

C. Secure pedestal base plate to subfloor with mechanical anchors.

D. Install additional pedestals where grid pattern is interrupted by room appurtenances or at cut-outs.

E. Install stringers and floor panels on pedestals with full bearing.

F. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.

G. Install plenum dividers to provide a positive air seal between structural floor and elevated floor. Provide gaskets and sealant to ensure airtight seal where holes are cut in elevated floor for penetration of cable.

H. Provide positive electrical earth grounding of entire floor assembly in accordance with NFPA 75.

I. Railings:
   1. Extend railing posts through floor panels to structural floor; secure to flange fittings anchored to structural floor.
   2. Brace posts in position at floor panels with floor collar retainers.
   3. Secure railings at walls with flanged fittings anchored to walls.

3.3 TOLERANCES

A. Maximum Out of Level Floor Panel Tolerance: 1/16 inch in 10 ft, non-cumulative.

3.4 ADJUSTING

A. Adjust pedestals to achieve a level floor and to assure adjacent floor panel surfaces are flush.

3.5 PROTECTION

A. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 09 9000

PAINTING AND COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, and other coatings.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically so indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 013515 - LEED Certification Procedures: LEED rating system definition.

B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 05 5000 - Metal Fabrications: Shop-primed items.

D. Section 05 5100 - Metal Stairs: Shop-primed items.

E. Section 09 9035 - Textured Coating.

F. Section 09 9715 - Acid Resistant Coating.

1.3 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on all finishing products, including VOC content.

C. Samples: Submit two painted samples, illustrating selected colors for each color and system selected. Submit on durable sheet material, 8 x 11 inch in size.

D. LEED Report: VOC content of all interior opaque coatings actually used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Paint and Coatings: 2 gallons of each color; store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

B. Single Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 JOB CONDITIONS

A. Environmental Requirements:
1. Comply with manufacturer's recommendations as to environmental conditions under which materials may be applied.
2. Apply no materials in spaces where dust is being generated.

B. Protections: Cover finished work of other trades and surfaces not being painted concurrently and prefinished items. "Wet Paint" signs shall be posted in all "Wet Paint" areas.

C. Safety Precautions:
1. Provide temporary fire protection equipment in materials' storage area.
2. Prohibit smoking in storage area.

D. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

E. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Materials selected for coating systems for each type surface shall be the product of a single manufacturer. Except as otherwise specified, materials shall be the products of the following manufacturers:
1. Benjamin Moore
2. Duron.
3. Glidden Professional and Devoe Coatings
4. Porter
5. PPG.
6. Sherwin Williams

B. Exterior concrete textured coating is specified in Section 09 9035.

2.2 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
1. Provide paints and coatings of a soft paste consistency, capable of being readily and

uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each coating material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:
1. Provide coatings that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Architectural coatings VOC limits of State in which the project is located.
   c. USGBC LEED Rating System, edition as stated in Section 013515; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

2.3 PAINT SYSTEMS - EXTERIOR

A. Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
2. Gloss: Two coats of alkyd enamel; .
   a. Benjamin Moore: M22 I.M.C. Urethane Alkyd Gloss Enamel.
   b. Duron: 12 Series Dura Clad Alkyd Gloss Enamel.
   c. Devoe: 4308 Devguard Alkyd Gloss Industrial Enamel..
   d. Porter: PP2700 Porter Guard Alkyd Gloss Enamel.
   e. PPG: 7-282 Pittsburgh Paints Industrial Oil Gloss.
   f. Sherwin Williams: B54Z Industrial Alkyd Gloss Enamel.

B. Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
   a. Benjamin Moore: MO7 I.M.C. Universal Alkyd Metal Primer.
   b. Duron: 33-105 Dura Clad Universal Acrylic Metal Primer.
   c. Devoe: 4160 Tank and Structural Primer.
   d. Porter: PPG 90-712 Pitt-Tech DTM Acrylic Metal Primer
   e. PPG: 90-712 Pitt-Tech Acrylic Metal Primer.
   f. Sherwin Williams: B50WZ3 Galvite Galvanized Metal Primer.
2. Gloss: Two coats of alkyd enamel; .
   a. Benjamin Moore: 133 Impervo Alkyd High Gloss Enamel.
   b. Duron: 12 Series Dura Clad Alkyd Gloss Enamel.
   c. Devoe: 4160 Tank and Structural Primer..
   d. Porter: PP2700 Porter Guard Alkyd Gloss Enamel.
   e. PPG: 7-282 Pittsburgh Paints Industrial Oil Gloss
   f. Sherwin Williams: B54Z Industrial Alkyd Gloss Enamel.

C. Pavement Marking Paint:
1. Yellow: Two coats,.
   a. Benjamin Moore: M58-10 I.M.C. Acrylic Safety & Zone Yellow Marking Paint.
   b. Duron: 994-8002 Lead Free Latex Zone Marking Paint, Yellow.
   c. Glidden: 85094 Hi Performance Yellow Acrylic Traffic Marking Paint.
   d. Porter: PP2412 Acrylic Yellow Traffic Marking Paint.
   e. PPG: 11-44 Speedhide Latex Traffic Paint Yellow.
   f. Sherwin Williams: TM225 Yellow Latex Traffic Marking Paint.

2. White: Two coats,.
    a. Benjamin Moore: M58-01 I.M.C. Acrylic Safety & Zone White Marking Paint.
    b. Duron: 994-8500 Lead Free Latex Zone Marking Paint, White.
    c. Glidden: 85094 Hi Performance White Acrylic Traffic Marking Paint.
    d. Porter: PP2408 Acrylic White Traffic Marking Paint.
    e. PPG: 11-23 Speedhide Latex Traffic Paint White.
    f. Sherwin Williams: TM226 White Latex Traffic Marking Paint.

2.4 PAINT SYSTEMS - INTERIOR - LOW VOC - LEED COMPLIANT

A. Wood, Opaque, Acrylic Latex, 3 Coat: (Low VOC)
1. One coat of acrylic primer sealer.
    a. Benjamin Moore:
    b. Duron:
    c. ICI:
    d. Porter: PP1129 Blankit Acrylic Enamel Undercoater (107 g/L).
    e. PPG: 17-955 Seal Grip Interior Latex Enamel Undercoater (96 g/L VOC).
    f. Sherwin Williams:
2. Semi-gloss: Two coats of acrylic latex enamel; .
    a. Benjamin Moore:
    b. Duron:
    c. ICI:
    d. Porter: PP6139 Pro Master 2000 Latex Semi-Gloss Enamel (108 g/L VOC).
    e. PPG: 6-500 Speedhide Latex Semi-Gloss Enamel (<50 g/L VOC
    f. Sherwin Williams:

B. Wood Work, Transparent, Stained with Polyurethane Finish, 3 Coat: (Low VOC)
1. One coat stain.
    a. Benjamin Moore:
    b. Duron:
    c. ICI:
    d. Porter: PPG Olympic 44500 Interior Low VOC Oil Based Wood Stain (240 g/L VOC)
    e. PPG: PPG Olympic 44500 Interior Low VOC Oil Based Wood Stain (240 g/L VOC)
    f. Sherwin Williams:
2. One coat polyurethane gloss:
    a. Benjamin Moore:
    b. Duron:
    c. ICI:
    d. Porter: PPG Olympic 42784 Interior Waterbased Polyurethane Gloss (<250 g/L VOC)
    e. PPG: PPG Olympic 42784 Interior Waterbased Polyurethane Gloss (<250 g/L VOC)
    f. Sherwin Williams:
3. One coat polyurethane satin:
    a. Benjamin Moore:
    b. Duron:
    c. ICI:
    d. Porter: PPG Olympic 42786 Interior Waterbased Polyurethane Satin (<250 g/L VOC)
    e. PPG: PPG Olympic 42786 Interior Waterbased Polyurethane Satin (<250 g/L VOC)
    f. Sherwin Williams:

C. Concrete Walls, Opaque, Latex, 2 Coat: (Low VOC)
1. One coat of latex primer sealer.
    a. Benjamin Moore: Fresh Start All Purpose 100% Acrylic Primer
    b. Duron: 04-123 Acrylic Enamel Undercoater

c. ICI:
d. Porter: PP867 Pro Master 2000 Latex Wall Primer (134 g/L VOC)
e. PPG: 6-2 Speedhide Latex Primer Sealer (<50 g/L VOC)
f. Sherwin Williams: B28W200 Prep-Rite 200 Latex Wall Primer

2. Flat: One coat of latex; .
a. Benjamin Moore: Eco Spec Interior
b. Duron: Genesis Odor Free Interior Acrylic Flat
c. ICI:
d. Porter: PP6109 Pro Master 2000 Latex Flat Wall Paint (50 g/L VOC)
e. PPG: 6-70 Speedhide Interior Latex Flat Wall Paint (<50 g/L VOC)
f. Sherwin Williams: B30-3200 Series ProMar 200 XP Latex Flat Wall Paint

D. Masonry, Opaque, Latex, 3 Coat: (Low VOC)
1. One coat of block filler.
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC)
e. PPG: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC)
f. Sherwin Williams:
2. Semi-gloss: Two coats of latex enamel; .
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: PP6139 Pro Master 2000 Latex Semi-Gloss Enamel (108 g/L VOC)
e. PPG: PP6139 Pro Master 2000 Latex Semi-Gloss Enamel (108 g/L VOC)
f. Sherwin Williams:

E. Masonry, Opaque, Waterborne Epoxy, 3 Coat: (Low VOC)
1. One coat of acrylic block filler.
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC)
e. PPG: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC)
f. Sherwin Williams:
2. Semi-gloss: Two coats of latex enamel; .
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: 16-510 Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi Gloss Epoxy(97 g/L VOC)
e. PPG: 16-510 Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi Gloss Epoxy (97 g/L VOC)
f. Sherwin Williams:

F. Ferrous and Galvanized Metals, Primed, Acrylic Enamel, 2 Coat: (Low VOC)
1. Touch up with acrylic primer.
a. Benjamin Moore: Super Spec HP. Acrylic Metal Primer
b. Duron: 33-305 Dura Clad Universal Acrylic Metal Primer
c. ICI:
d. Porter: PPG 90-712 Pitt Tech DTM Acrylic Metal Primer (123 g/L VOC)
e. PPG: 90-712 Pitt Tech DTM Acrylic Metal Primer (123 g/L VOC)
f. Sherwin Williams: B66-310 Series Pro Industrial ProCryl Universal Primer.
2. Semi-gloss: Two coats of acrylic enamel; .
a. Benjamin Moore: M29 I.M.C. DTM 100% Acrylic Semi-Gloss Enamel
b. Duron: 122 Series Plastic Kote Interior Acrylic Latex Semi Gloss Enamel

c. ICI:
d. Porter: 90-1210 PittTech Plus DTM Waterborne Acrylic Semi-Gloss (90 g/L VOC)
e. PPG: 7-374 Pittsburgh Paints Semi Gloss Acrylic Metal Finish (82 g/L VOC)
f. Sherwin Williams: B66-600 Pro Industrial 0 VOC Acrylic Semi-Gloss.

G. Gypsum Board, Latex-Acrylic, 3 Coat: (Low VOC)
1. One coat of latex primer sealer.
a. Benjamin Moore: Fresh Start All Purpose 100% Acrylic Primer 023..
b. Duron: 04-124 Interior Latex Drywall Vinyl Primer
c. ICI:
d. Porter: PP867 Pro Master 2000 Latex Primer Sealer
e. PPG: 6-2 Speedhide Latex Primer Sealer (<50 g/L VOC)
f. Sherwin Williams: B28W200 Prep-Rite 200 Latex Primer
2. Eggshell: Two coats of latex-acrylic enamel; .
a. Benjamin Moore: C274 Super Spec Acrylic Latex Eggshell Enamel
b. Duron: 36 Series Ultra Deluxe Interior Acrylic Latex Eggshell Enamel
c. ICI: 1412 Ultra-Hide Acrylic Latex Eggshell Enamel
d. Porter: PP6129 Pro Master 2000 Latex Eggshell Enamel (66 g/L VOC)
e. PPG: 6-411 Speedhide Latex Eggshell Enamel (<50 g/L VOC)
f. Sherwin Williams: B20W2251 ProMar 200 Acrylic Latex Eggshell Enamel
3. Flat: Two coats of latex acrylic; .
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: PP6109 Pro Master 2000 Latex Flat Wall Paint (50 g/L VOC)
e. PPG: 6-70 Speedhide Interior Latex Flat Wall Paint (<50 g/L VOC)
f. Sherwin Williams:
4. Semi-Gloss: Two coats of latex acrylic; .
a. Benjamin Moore:
b. Duron:
c. ICI:
d. Porter: PP6139 Pro Master 2000 Latex Semi-Gloss Enamel (108 g/L VOC)
e. PPG: 6-500 Speedhide Latex Semi-Gloss Enamel (<50 g/L VOC)
f. Sherwin Williams:

H. Gypsum Board, Epoxy, 3 Coat: (Low VOC)
1. One coat of primer.
a. Benjamin Moore: Fresh Start All Purpose 100% Acrylic Primer 023.
b. Duron: 04-123 Acrylic Enamel Undercoater
c. ICI:
d. Porter: PP867 Pro Master 2000 Latex Wall Primer (134 g/L VOC)
e. PPG: 6-2 Speedhide Latex Primer Sealer (<50 g/L VOC)
f. Sherwin Williams: B28W200PrepRite 200 Latex Wall Primer
2. Semi-gloss: Two coats of epoxy
a. Benjamin Moore: Super Spec 100% Semi-Gloss Enamel.
b. Duron: 122 Series Plastic Kote Interior Acrylic Latex Semi-Gloss Enamel.
c. ICI:
d. Porter: 16-510 Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi Gloss Epoxy(97 g/L VOC)
e. PPG: 16-510 Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi Gloss Epoxy (97 g/L VOC)
f. Sherwin Williams: B70-W211 Water Based Catalyzed Epoxy

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Application of primers, paints, stains or finishes represents acceptance by the contractor that the surfaces were properly prepared and suitable for application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

I. Concrete Floors and Traffic Surfaces to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

J. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

K. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

L. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

M. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

N. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

O. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

P. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

E. Apply paint, enamel, stain and varnish with suitable brushes, rollers or spraying equipment.
   1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved.
   2. Keep brushes and rollers and spraying equipment clean, dry, free from contaminates and suitable for the finish required.
   3. Apply stain by brush.

F. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.

G. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

H. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

I. Change colors at corner of stop where colors differ between adjoining spaces or rooms and where door frames match wall colors.

J. Where portion of finish or drywall partition is damaged or unacceptable, refinish entire surface of partition.

K. Backprime exterior carpentry and millwork with material specified for prime coat, without runs on face. Finish cut edges just prior to installation.

L. Paint inside of ductwork flat black for entire area visible through ceiling openings. Paint underside of ductwork and other above-ceiling items flat black for entire area visible through ceiling openings.

M. Apply stains to wood doors in a horizontal position to permit easier handling of materials and prevent solvents from evaporating too quickly.

N. Finish all edges of exterior doors same as faces.

O. The number of coats specified are minimum. The Contractor shall provide at no additional

cost to the Owner, as many coats as necessary for color coverage conformity and uniform appearance.

P. Sand wood and metal surfaces lightly between coats to achieve required finish.

Q. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch up and restore finish where damaged. Remove spilled, splashed or splattered paint from all surfaces.

C. Do not mar surface finish of item being cleaned.

3.6 SCHEDULE - SURFACES TO BE FINISHED

A. Do Not Paint or Finish the Following Items:
1. Items fully factory-finished unless specifically noted.
2. Fire rating labels, equipment serial number and capacity labels.
3. Stainless steel items.
4. Structural steel roof framing, joists, and bridging.
5. Piping, conduit, and ductwork unless specifically noted.
6. Galvanized exterior stairs and railings.

B. Exterior Surfaces to be painted:
1. All hollow metal doors and frames.
2. All bollards.
3. All pipe railings and handrails.
4. Ladders, safety cages.
5. Dock edge angles.
6. All exposed piping.
7. Gas piping on roof.
8. Downspout guards.
9. All other exposed metal except prefinished items.

C. Interior Surfaces to be painted:
1. All walls scheduled for paint.
2. Interior concrete wall panels scheduled to be painted.
3. All hollow metal doors and frames.
4. Bollards.
5. Ladders, safety cages.
6. Stairs and railings.
7. Guardrails.
8. Dock edge angles.
9. Sprinkler risers up to the turn out at ceiling level.

D. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

END OF SECTION

SECTION 09 9035

TEXTURED COATINGS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Textured coating on exterior concrete wall surfaces and light pole bases.

B. Pressure washing of concrete wall panels.

1.2 RELATED WORK:

A. Section 03 3000 - Cast-In-Place Concrete.

B. Section 03 4713 - Tilt-Up Concrete.

C. Section 09 9000 - Painting and Coating.

1.3 REFERENCE STANDARDS:

A. ASTM E-84 test for surface burning characteristics of building materials.

1.4 QUALITY ASSURANCE:

A. Product Manufacturer: Company specializing in the manufacturing of quality textured coating products with a minimum of 10 years experience.

B. Application: Company specializing in commercial application with 3 years experience on projects of similar scope.

1.5 REGULATORY REQUIREMENTS:

A. Comply with applicable city, county, state and federal requirements and ordinances regarding maximum V.O.C. (Volatile Organic Compound) content.

B. Conform to applicable building code for flame/fuel/smoke rating requirements for finishes.

1.6 SUBMITTALS:

A. Submit product data for specified products under provisions of Section 01 3000. Include all performance and physical data, including material safety data sheets.

B. Submit letter from manufacturer indicating quantity of material required to provide the dry film thickness specified.

C. Submit manufacturer's installation instructions under provisions of Section 01 3000.

D. Submit minimum 2 samples 8 x 8 inches in size of material applied to appropriate substrate.

E. Submit from manufacturer 3 copies of sample warranty and letter stating intent to provide 5 year warranty.

1.7 MOCK-UP PANELS:

A. At a location approved by Architect, paint one full size concrete wall panel with all base colors and accent stripes. This process may be repeated up to 3 more times (using adjacent panels) at no additional cost to Owner.

B. Accepted mock-up may be included as part of final work.

1.8 ENVIRONMENTAL REQUIREMENTS:

A. Maintain ambient temperature at 70 degrees F for three days or above 50 degrees F for five days.

B. Provide adequate ventilation during application.

C. Provide adequate illumination.

1.9 DELIVERY STORAGE AND HANDLING:

A. Deliver products to site under provisions of Section 01 6000.

B. Deliver materials in original containers with seals unbroken and labels intact.

C. Store materials and equipment in a protected, climate controlled area of project site.

D. Comply with applicable health and fire regulations.

E. Store materials at ambient temperatures of 45 degrees F minimum, and 90 degrees F maximum, in well ventilated area.

1.10 SCAFFOLDS AND PROTECTION:

A. Provide adequate, safe ladders, scaffolds and stages necessary to complete work.

B. Protect completed finish coating work and adjacent finish surfaces from coating splatter, spills and stains. Use adequate drop cloths and masking procedures during progress of work.

1.11 WARRANTY:

A. Provide manufacturer's 5 year written warranty for material replacement only due to chipping, flaking, peeling, delamination or blistering of coating from the underlying surface.

1.12 EXTRA MATERIALS:

A. Provide five extra gallons of each color of material used.

PART 2 - MATERIALS

2.1 ACCEPTABLE PRODUCTS:

A. Water Based Acrylic:
   1. National Coating & Mfg: Contact Jerry Wilcher at 580-332-8751.
      a. Base Coat: FlexKote - Coarse Texture.
      b. Finish Coat: 100% Pure Acrylic.
      c. Accent Color: 100% Pure Acrylic.
   2. Textured Coating of America:
      a. Base Coat: TexCote 300 Textured Coating – Coarse Texture.
      b. Finish Coat: DF Color-Cote Dead Flat.
      c. Accent Color: DF Color-Cote Dead Flat.
   3. Thoro Systems:
      a. Base Coat: Thorocoat Tex.
      b. Finish Coat: Thorosheen.
      c. Accent Coat: Thorosheen.
   4. Sherwin Williams:
      a. Base Coat: UltraCrete – Medium Texture.
      b. Finish Coat: Loxon Acrylic Coating
      c. Accent Color: Loxon Acrylic Coating
   5. PPG Paints:
      a. Base Coat: 4-60 Permacrete Texture Coating – Medium Texture.
      b. Finish Coat: 4-22 Permacrete High Build Acrylic Topcoat.

c. Accent Color: 4-22 Permacrete High Build Acrylic Topcoat.

B. Solvent Based Vinyl Toluene Acrylic:
   1. Textured Coating of America:
      a. Finish Coat: TexCote – XL70 – Coarse Texture.
      b. Accent Color: DF Color-Cote Dead Flat.

2.2 MATERIALS:

A. Materials shall be pre-mixed.

B. Coverage:
   1. Apply textured coating as required by manufacturer, approximately 50 to 60 square feet per gallon (10 to 12 mils DFT for water based and 16 to 18 mils DFT for solvent based). Additional coats may be required for uniform textured appearance.
   2. Apply topcoat coating as required by manufacturer, approximately 200 square feet per gallon (4 mils DFT).

C. Color: Custom colors as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. See Section 03 4713 - Tilt-Up Concrete for surface preparation and repair of minor defects in concrete wall panels.

B. Examine surfaces scheduled to receive coating for conditions that will adversely affect execution, perseverance, or quality of finish work, and which cannot be put into an acceptable condition through normal preparatory work. Notify Architect in writing of such unacceptable conditions.

C. Do not proceed with surface preparation or coating applications until conditions are suitable.

D. Application of coating or finish to surfaces shall constitute acceptance of that surface.

3.2 PREPARATION:

A. Clean surfaces which affect work of this section.

B. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust.

C. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

D. Concrete: Chip or grind off all defective materials and foreign matter. Remove form treatment residue, curing compound, scum and fungus. Repair cracks, breaks, honeycombing, or other surface imperfections with non-expansive patching mortar to attain a finish comparable to adjacent concrete surface.

E. Pressure wash exterior face of concrete surfaces to be coated. Comply with manufacturer's recommendations for cleaning solutions to be used.

3.3 APPLICATION:

A. The intent of these specifications is to produce the highest quality appearance coating and finish surfaces. Employ skilled mechanics only. Comply with manufacturer's printed specifications for application. Allow repairs to properly cure before beginning installation.

B. Do not apply coatings while surface is damp, or during cold, rainy, or frosty weather, or when temperature is below 40 degrees F nor under conditions where temperature may drop below

40 degrees F within 24 hours after application. Cool surfaces exposed to hot sun by hosing with clean water.

C. Spray apply mixture to specified thickness.

D. Ensure that finished surfaces are uniform in texture, color, and thickness without noticeable "overlap" marks, or streaky appearance.

E. Utilize application equipment specifically recommended by coating manufacturer.

F. The number of coats specified are minimum. At no extra charge to Owner, additional coats shall be provided to achieve color and appearance uniformity.

G. Manufacturer's technical representative shall visit job-site for review and approval of mock-up sample. Do not proceed with work until manufacturer and Architect provide written acceptance of mock-up.

3.4 PROTECTION:

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and other protective coverings to prevent spray or drippings from disfiguring other surfaces.

D. Remove empty containers from site.

3.5 CLEANING/TOUCH-UP:

A. As work proceeds, promptly remove coating where spilled, splashed, or spattered.

B. During progress of work, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect waste, cloths, and material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

D. Spot touch-up will be allowed to correct soiled or damaged surfaces only when spot will blend into surrounding finish and is invisible to normal viewing. Otherwise recoat entire section to nearest corners or visible stopping point.

END OF SECTION

SECTION 09 9715

ACID RESISTANT COATING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Fluid applied, 100% reactive, low odor epoxy flooring.

1.2 RELATED WORK:

A. Section 03 3000 - Cast-In-Place Concrete.

B. Section 03 3513 - High Toilerance Concrete Floor Finishing.

1.3 REFERENCES:

A. ASTM D 4259-88 - Practice for Abrading Concrete.

B. ASTM F1869-04 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.4 SUBMITTALS:

A. Product Data: Provide manufacturer data on specified products.

B. Samples: Submit three 4” x 6” samples indicating color and sheen.

C. Manufacturer's Installation Instructions: Indicate special procedures.

1.5 QUALITY ASSURANCE:

A. Application: Company specializing in commercial application with 5 years experience on projects of similar scope.

1.6 REGULATORY REQUIREMENTS:

A. Comply with applicable city, county, state and federal requirements and ordinances regarding maximum V.O.C. (Volatile Organic Compound) content.

1.7 DELIVERY STORAGE AND HANDLING:

A. Deliver products to site under provisions of Section 01600.

B. Deliver materials in original containers with seals unbroken and labels intact.

C. Store materials and equipment for three days prior to installation in area of installation to achieve temperature stability..

D. Comply with applicable health and fire regulations.

1.8 WARRANTY

A. Provide two year warranty against flooring delamination from substrate and degradation of surface finish under normal wear conditions.

PART 2 - MATERIALS

2.1 HIGH BUILD EPOXY FLOORING

A. Acceptable Products:
   1. Garland Floor Co; Product Chemi-Cote EPHB-CR.
   2. Substitutions: See Section 01600 - Product Requirements.

B. Epoxy, two component, high performance, chemical resistant, colored with aggregate broadcast on base coat.
   1. Primer: EPHB-CR Primer, 7 mils wet film thickness.
   2. Base Coat: EPHB-CR, pigmented, 10 to 15 mils wet film thickness.
   3. Top Coat: EPHB-CR, pigmented, 10 to 15 mils wet film thickness.
   4. Non-slip Surfacing: Fine graded silica sand, 30-40 mesh.
   5. Cycloaliphatic curing agent or equal.
   6. Capable of resisting spills containing up to 57% solution of sulphuric acid without damage to coating.
   7. Color: Red.

2.2 EPOXY FLOOR COATING

A. Acceptable Products:
   1. Dayton Superior: Day-Chem Poxy Plus J-36.
   2. Euclid: Eucopoxy Tufcoat VOX.
   3. General Polymers: 3744 High Performance CR Epoxy.
   4. Nox-Crete: Dauerseal 60E.
   5. PPG Industries, Inc.: 99-1001 Series Megaseal TF Epoxy.
   6. Substitutions: See Section 01600 - Product Requirements.

B. Epoxy, two component, chemical resistant, colored.
   1. Primer: Recommended by manufacturer, 4 to 6 mils dry film thickness.
   2. Base and Top Coat: Pigmented, 6 to 8 mils dry film thickness.
   3. Capable of resisting spills containing up to 20% solution of sulphuric acid without damage to coating.
   4. Color: Dark Gray.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that concrete surfaces have cured for not less than 30 days.

B. Examine surfaces scheduled to receive coating for conditions that will adversely affect execution, perseverance, or quality of finish work, and which cannot be put into an acceptable condition through normal preparatory work. Notify Architect in writing of such unacceptable conditions.

C. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
   1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
   2. Alkalinity: pH range of 5-9.

D. Do not proceed with surface preparation or coating applications until conditions are suitable.

E. Application of coating or finish to surfaces shall constitute acceptance of that surface.

3.2 PREPARATION:

A. Concrete surface shall be mechanically abraded in accordance with ASTM D-4259, using sandblast, shotblast or scarifier which will give an open surface profile to a minimum texture of coarse grit sandpaper. Completely remove all residue with a vacuum cleaner or pressure

washing.

B. Acid etching is not an acceptable method.

C. Keying: Where epoxy coating does not extend continuously from wall to wall, a key 1/2 wide x 1/2 inch deep, shall be cut around perimeter of area. Keying shall also be performed at doorways.

3.3 INSTALLATION - FLOORING

A. Primer: Apply primer to prepared concrete substrate at a rate sufficient to result in a complete wetting-out and sealing of concrete with no dry areas.

B. Finish Coats: Apply two coat application of epoxy coating. Mix all materials in accordance with manufacturer's instructions. Apply the product by squeegee, roller or industrial sprayer. After final application, back-roll the area to reduce surface imperfections and provide smooth uniform appearance. Total dryfilm thickness of system shall be minimum 8 mils.

3.4 PROTECTION:

A. No traffic shall be allowed for a minimum of 3 to 10 days depending upon curing temperature. No movement of heavy equipment shall be allowed for 10 days.

B. Protect coated surfaces from damage during subsequent construction operations.

END OF SECTION 09860

SECTION 10 1400

SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior signage of the following types:
   1. ADA compliant interior signage, without borders.

B. Informational Exterior and Interior Signage.

1.2 REFERENCES

A. ANSI/ICC A117.1 - Accessible and Useable Buildings and Facilities; 2003.

B. ATBCB ADAAG - Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG); U.S. Architectural Transportation Barriers Compliance Board; 2004.

1.3 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature.

B. Shop Drawings: List sign styles, lettering, locations and dimensions of each interior sign.

C. Selection Samples: One complete set of color chips representing manufacturer's full range of available colors.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of ANSI/ICC A117.1 and ADAAG.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

A. ADA-Compliant Interior Signage, Borderless:
   1. Type: Three-in-one construction without borders; three-ply melamine plastic laminate with phenolic core signs with lettering and symbols raised 1/32 inch from sign plate face.
   2. Sign Thickness: 1/8 inch thick.
   3. Construction: One-piece; added-on or engraved characters not acceptable.
   4. Lettering Style: Helvetica Medium, upper case.
   5. Braille: Grade 2 Braille, placed directly below last line of letters or numbers.
   6. Performance: Non-static, fire-retardant, and self-extinguishing.
   7. Contrast: Letters numbers and symbols shall contrast with background.
   8. Corners: Square.
   9. Color of Plastic: As selected from manufacturer's standard colors.
   10. Finish of Plastic: Matte.
   11. Color of Background: As selected from manufacturer's standard paint colors.
   12. Letter and Number Sizes:
      a. Lettering for restroom identification, minimum 3/4 inch high; corresponding symbols minimum 4 inches high; symbol on symbol only signs minimum 3-1/2 inch high.
   13. Sign Sizes:
      a. Restroom and symbol signs, 8 by 8 inches.
      b. Exit signs, 8 by 4 inches.

2.2 INFORMATIONAL SIGNS

A. Wall Mounted Aluminum Panel Signs:
   1. Aluminum Sheet: Provide aluminum sheet, minimum .063 inch thick. Fabricate panels with edges mechanically and smoothly finished.
      a. Finish: Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
      b. Color: White color.
   2. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
      a. Applied Copy: Die-cut characters from vinyl film with pressure-sensitive adhesive backing. Apply copy to the exposed face of the sign panel.
      b. Font: All letters and numbers shall be Helvetica Black font. Color shall be black.

B. Door Mounted Vinyl Signs:
   1. Exterior Hollow Metal Doors: Provide 8” high die-cut numbers (four digit number) on inside and outside of all exterior hollow metal doors. Center on door at 5 feet AFF.
   2. Dock Doors: Provide 10” high die-cut numbers (four digit number) on inside of all dock doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine installation areas to ensure that conditions are suitable for installation.

B. Examine signage for defects prior to installation. Do not install damaged signage.

3.2 PREPARATION

A. Verify mounting heights and locations for interior signage will comply with referenced standards.

B. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation.

3.3 INSTALLATION

A. Install signs level, plumb, without distortion, and in proper relationship with adjacent surfaces using manufacturer's recommended standard mounting system.
   1. Vinyl Tape Mounting: Use vinyl foam tape to secure signs to interior wall surfaces.
   2. Pin Mounting: Provide stainless steel pins to secure panels to exterior concrete walls.

B. Remove adhesive from exposed sign surfaces as recommended by manufacturer.

C. Clean signs after installation as recommended by manufacturer.

D. Replace damaged products before Substantial Completion.

3.4 SIGNAGE SCHEDULE

A. Restroom Door Sign: Provide "MEN" and "WOMEN" signs with handicap symbol.

B. Exterior Sign above Dock Doors: 24" w x 18" high aluminum panel with 12" high letters. Each sign will have 3 digits. Mount on exterior of building above each dock door. Coordinate with Owner for numbering sequence.

C. Exterior Hollow Metal Doors: 4 digit number on inside and exterior of door. Coordinate with Owner for numbering sequence.

D. Dock Doors: 3 digit number on inside of dock door. Coordinate with Owner for numbering

sequence.

END OF SECTION

SECTION 10 2113.19

PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid phenolic core toilet compartments; floor mounted overhead braced.

B. Solid phenolic core urinal screens; wall mounted.

1.2 RELATED SECTIONS

A. Section 06 1000 - Rough Carpentry: Concealed wood framing and blocking for compartment support.

B. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCES

A. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Samples: Submit two samples of partition panels, 2 x 2 inch in size illustrating panel finish, color, and sheen.

1.5 COORDINATION

A. Coordinate the work with placement of support framing and anchors in wall.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Phenolic Core Toilet Compartments:
   1. Ampco Products, Inc; Product ____: www.ampco.com.
   2. Bobrick.
   3. Global Steel Products.
   4. Substitutions: Section 01 6000 - Product Requirements.

2.2 COMPONENTS

A. Toilet Compartments: Solid phenolic core high pressure decorative laminate panels, doors, and pilasters, floor-mounted headrail-braced.

B. Door and Panel Dimensions:
   1. Door Thickness: 3/4 inch.
   2. Panel Thickness: 1/2 inch.
   3. Door Width: 24 inch.
   4. Door Width for Handicapped Use: 36 inch, out-swinging.

5. Height: 58 inch.
6. Thickness of Pilasters: 3/4 inch.

C. Urinal Screens: Wall mounted with continuous full height U-bracket.
1. Width: 18 inch
2. Height: 48 inch

2.3 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A 666, Type 304 stainless steel with No. 4 finish, 3 in high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.

C. Pilaster Brackets: Polished stainless steel.

D. Wall Brackets: Continuous type, polished stainless steel.

E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

F. Hardware: Polished stainless steel:
1. Pivot hinges, gravity type, adjustable for door close positioning; three per door.
2. Door Latch: Slide type with exterior emergency access feature.
3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
5. Provide door pull for outswinging doors.

2.4 CONSTRUCTION

A. Construction shall be of solid phenolic core decorative plastic laminate with multiple resin-impregnated kraft and surface sheets fused at high temperature and pressure. The edges shall be polished black, chamfered and free of milling marks. Material shall be Class B fire rating.

B. Furnish galvanized steel supports and leveling bolts at stiles to suit floor conditions as recommended by the manufacturer. Provide shoe at each stile.

C. Headrail shall be provided to bridge all compartments and brace the end freestanding pilasters to the wall.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify correct spacing of and between plumbing fixtures.

B. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2226.33

FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acoustic operable panel partition.

B. Ceiling track and operating hardware.

1.2 RELATED REQUIREMENTS

A. Section 05500 - Metal Fabrications: Overhead track structural support framing.

B. Section 06100 - Rough Carpentry: Wood blocking and track support shimming.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2012.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

C. ASTM E413 - Classification for Rating Sound Insulation; 2010.

D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.

1.4 SUBMITTALS

A. Product Data: Provide data on partition materials.

B. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, and stacking depth.

C. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Design is based on Hufcor, Inc; Product #632.
   1. Substitutions: See Section 01 6000 - Product Requirements

2.2 COMPONENTS

A. Operable Panel Partition: Side opening; paired panels; center stacking; manually operated.
   1. Panel Finish: Upgrade vinyl consisting of Type II, reinforced vinyl weighing maximum 20 oz./lin. yard..
   2. Sound Transmission Class (STC): 49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.

3. Surface Burning Characteristics of Panel Finish: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
4. Maximum Panel Weight: 8.9 lb/ sq. ft.
5. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

B. Panel Construction:
1. Panels shall be nominally 3 inch thick, to 48 inch in width, and hinged in groups of two or three.
2. Panel faces shall be Class A rated gypsum laminated to appropriate substrate to meet the STC requirements.
3. Frames shall be minimum of 18 gage painted steel formed to capture and protect vertical edges of the face material.
4. Lead panel shall be bulb seal, to seal against the adjacent wall without the need for wall mounted jambs.
5. Final closure panel shall be lever panel closure, unhinged single panel.
6. top seals shall be continuous contact multi-ply vinyl.
7. Horizontal bottom seals shall be retractable, provide a maximum of 2 inches nominal operating clearance, and exert downward force when extended.

C. Operation: Panels shall be top supported by two (2) carriers featuring dual horizontal precision bearings with high strength polymer tires riding on a structural aluminum track.

D. Track: Extruded aluminum; 2-1/2 x 4-3/4 inches size; thickness and profile designed to support loads, .

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

3.2 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Fit and align partition assembly level and plumb.

C. Lubricate moving components.

D. Apply acoustic sealant to achieve required acoustic performance.

3.3 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.4 CLEANING

A. Clean finish surfaces and partition accessories.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition, identify potential operational problems.

END OF SECTION

SECTION 10 2800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Accessories for toilet rooms and utility rooms.

B. Grab bars.

1.2 RELATED REQUIREMENTS

A. Section 06100 - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.

B. Section 08800 - Glazing: Unframed mirrors.

C. Section 10 2113.19 - Phenolic Toilet Compartments.

1.3 SUBMITTALS

A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

1.4 COORDINATION

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.5 WARRANTY:

A. Warrant work to be free from defects in materials and workmanship, for a period of two years, beginning at Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Toilet Accessories:
   1. American Specialties, Inc.
   2. Bobrick Corporation.
   3. Georgia Pacific.
   4. GOJO
   5. Excel Dryer
   6. Substitutions: Section 01 6000 - Product Requirements.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

2.3 FINISHES

A. Stainless Steel: No. 4 satin brushed finish.

B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish.

2.4 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: High capacity, jumbo double roll, surface mounted, high impact gray plastic unit.
   1. Georgia Pacific #GEP59209.
   2. No substitutions.

B. Touchless Paper Towel Dispenser: Roll paper type, stainless steel unit, semi-recessed.
   1. Georgia Pacific "enMotion" #59466.
   2. No substitutions.

C. Electric Hand Dryer: Semi-recessed, brushed stainless steel unit.
   1. Excel Dryer: "XLerator" #XL-SB with ADA compliant recess kit..
   2. No substitutions.
   3. Voltage: 110 volts, 12.5 amp, 60 hz.
   4. Air Heater: 900 watts.

D. Automatic Soap Dispenser: Wall mounted.
   1. GOJO model TFX.
   2. No substitutions.

E. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
   1. Size: 18 inch x 36 inch.
   2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
   3. Bobrick #B165 x 1836.
   4. ASI #0620 x 1836

F. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
   1. Bobrick
   2. ASI #0477-SM.

G. Grab Bars: Stainless steel, nonslip grasping surface finish.

H. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. Bobrick #B6806; shape and size as indicated on the drawings.
   2. ASI #3200; shape and size as indicated on the drawings.

I. Combination Sanitary Napkin/Tampon Dispenser: Stainless steel, surface-mounted.
   1. Bobrick #352.
   2. ASI #0464.
   3. Operation: 25 cent coin required to operate dispenser. Provide locked coin box, separately keyed.

J. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
   1. Bobrick #B270.
   2. ASI #0852.

2.5 UTILITY ROOM ACCESSORIES

A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
   1. Holders: 4 spring-loaded rubber cam holders.
   2. Length: 36 inches.
   3. Bobrick #B223-36.
   4. ASI #8215-4.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION

SECTION 10 4400

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2010.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.5 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguisher Cabinets and Accessories:
   1. JL Industries, Inc: www.jlindustries.com.
   2. Larsen's Manufacturing Co: www.larsensmfg.com.
   3. Potter-Roemer: www.potterroemer.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multi-Purpose Dry Chemical Type: Steel tank, with pressure gage.
   1. Size and classification:
      a. Office Areas: 5 lb. minimum, 2A-10B:C.
      b. Warehouse Areas: 10 lb. minimum, 4A-60B:C.
   2. Finish: Baked enamel, red color.

2.3 FIRE EXTINGUISHER CABINETS

A. Cabinet Box Metal: Formed galvanized steel sheet; 0.036 inch thick base metal.

B. Doors and Trim Metal: Formed aluminum.

C. Cabinet Configuration: Semi-recessed type.
   1. Exterior nominal dimensions of 10 inch wide x 24 inch high x 6 inch deep.
   2. Trim: Rolled edge returned to wall surface, with 2-1/2 inch projection.

D. Door Glazing: Narrow glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.

E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.

F. Weld, fill, and grind components smooth.

G. Finish of Cabinet Exterior Trim and Door: Anodized to clear aluminum color.

H. Finish of Cabinet Interior: White enamel.

2.4 ACCESSORIES

A. Extinguisher Brackets: Formed steel, galvanized and enamel finished. Heavy duty bracket providing top and bottom support fore extinguisher.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

E. Install wall/column mounted fire extinguishers in Warehouse as directed by Fire Marshall.

3.3 SCHEDULES

A. Warehouse area and elevated platform area: Unless indicated otherwise, provide wall/column mounted extinguishers at a rate of 1 per 6,000 sq. ft.

B. Office Area: Unless indicated otherwise, provide fire extinguisher and cabinet at a rate of 1 per 3,000 sq.ft.

END OF SECTION

SECTION 10 5100

LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heavy duty steel locker units with hinged doors.

B. Metal tops and filler panels.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on locker types, sizes and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan.

D. Samples: Submit two samples 3 x 6 inches in size, of each color scheduled; applied to specified base metal.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Lockers:
   1. Lockup Lockers.

2.2 MATERIALS

A. Sheet Steel: ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; to the following minimum thicknesses:
   1. Body and Shelf: 24 gage.
   2. Door Frame: 16 gage.
   3. Hinges: 14 gage, 5 knuckle, full-loop hinge.
   4. Base: 12 gage Z-type.
   5. Sloping Top: 20 gage.

B. 3/16 inch thick polycarbonate door.

2.3 LOCKER UNITS

A. Width: 12 inches.

B. Depth: 12 inches.

C. Height: 12 inches per opening.

D. Configuration: Six tier.

E. Base: Metal base.
   1. Base Height: 6 inch.

F. Top: Sloped metal with closures.

G. Locking: Digilock electronic lock.

H. Color: Red

I. Number Plates: Provide rectangular shaped aluminum plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.

J. Finish edges smooth without burrs.

K. Fabricate sloped metal tops, ends and closure pieces.

2.4 FINISHING

A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lockers plumb and square.

C. Place and secure on prepared base.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels, filler panels, and sloped tops.

G. Install accessories.

3.2 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 7320

DOCK CANOPY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Pre-engineered, pre-finished aluminum canopies.
   1. Cantilevered hanger type with custom bullnose fascia.
   2. Structural steel tube support.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 07 9005 - Caulking and Sealants: caulking joint between canopy and wall.

1.3 PERFORMANCE REQUIREMENTS:

A. Design canopy and framing to support local design loads:
   1. Wind Speed: 90 mph
   2. Ground Snow Load: 20 psf.

1.4 SUBMITTALS:

A. Product Data: Submit fabricator's specifications and installation instructions for products specified in this Section.

B. Shop Drawings: Submit shop drawings for the fabrication of each item of metal work. Information noted shall include plans, elevations, and details showing jointings, anchorage, and all accessory items with finishes noted.

C. Design Calculations: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the project is located. Furnish stamped engineered calculations.

D. Samples: Submit two samples for finish approval:
   1. 4 x 4 inch color sample of bullnose fascia metal.

1.5 STORAGE AND HANDLING

A. Handle materials to prevent damage to prefinished surfaces. Install no components which have been damaged or stained beyond repair. The Architect shall be the sole judge of whether a damaged or stained member may be repaired or refinished for use

B. Protect all installations for remainder of project from damage caused by work of other trades.

1.6 COORDINATION:

A. Work under this Section shall be coordinated with other trades so that a single installer shall have responsibility for the complete assembly.

1.7 ASSURANCE STANDARDS:

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fittings of work.

B. Shop Assembly: Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinate installation.

C. Inserts and anchorages shall be furnished. Provide setting drawings, templates and

instructions for installation of items. Coordinate delivery to avoid delays.

1.8 QUALITY CRITERIA:

A. Comply with the provisions of the following standards except where specified to the contrary elsewhere in this Section.
   1. The Aluminum Association (A.A.)
      a. “Designation System of Aluminum Finishes.”
      b. “Aluminum Standards and Data.”
   2. The National Association of Architectural Metal Manufacturers (NAAMM).

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. Materials shall be free from defects impairing strength, durability or appearance, having structural properties to sustain or withstand strains and stresses to which subjected. Exposed surfaces throughout project shall have the same inherent texture and color for like locations. Fasteners shall be non-corrosive, non-staining and concealed, except as indicated on approved shop drawings.

B. Fasteners which must be exposed shall be of same materials, color and finish as materials to which applied. Countersink and finish flush all fasteners unless indicated otherwise on shop drawings. Exposed welds shall be ground smooth to form a neat uniform fillet without weakening base metal. Unexposed welds shall have slag removed before applying shop coating. Moulded, bent or shaped members shall be formed with clean, sharp arises, without dents, scratches, cracks and other defects, provide anchors, bolts, shims, and accessory items for building into and fastening to adjacent work.

2.2 SYSTEM DESCRIPTION:

A. Dock Canopy:
   1. Description: consists of structural aluminum panels bounded by break metal fascia which act as gutters. Canopy and the connections to the structural support shall be designed to resist design windloads. Gutters shall drain through the bottom of fascia by means of scuppers.
   2. Method of Support:
      a. Canopies shall be supported from cantilevered structural steel tube supports anchored to wall. See drawings for locations. Tubes to be hot dip galvanized.

B. Canopy Roof Panel: Self-supporting aluminum panel 3 inches deep.
   1. Equal to Mason Corporation - "Structural W Panel”.
   2. Thickness: 0.032 inches minimum.
   3. Finish: Factory-applied baked-on enamel.
   4. Color: White.

C. Gutter/Fascia: Rolled formed aluminum properties are:
   1. Equal to Mason Corporation – ".050" R-F Fascia".
   2. Size: 6 inches high.
   3. Thickness: 0.050 inches.
   4. Finish: Factory-applied baked-on enamel.
   5. Color: White.

D. Custom Bullnose Fascia: 0.032" aluminum bullnose fascia with smooth radius. Finish to be Kynar 500 custom red color.

E. Hardware: All hardware up to 1/4 " inch in diameter shall be stainless steel. Items larger shall be galvanized steel and comply with ASTM B117 (Hass Test) for 200 hours.

2.3 MISCELLANEOUS MATERIALS:

A. Inserts and anchorage items: Provide appropriate types with hot dip galvanized coatings where metal components are fixed into concrete panels. Select fasteners of type, grade and class required for installation of metal components as indicated on the drawings and specified herein.
   1. Bolts and nuts: Regular hexagon type.
   2. Machine screws: Cadmium plated.
   3. Plain washers: Round, carbon steel.
   4. Lock washers: Helical spring type carbon steel.
   5. Lead expansion shields and lag bolts: Approved types.

B. Gasket and sealant materials noted on drawings shall comply with Section 07920.

PART 3 - EXECUTION

3.1 FABRICATION:

A. Form metalwork to the required shapes and sizes with true curves lines and angles. Use concealed fasteners wherever possible the metal from which principal components are fabricated.

B. Where permanent joinery of components is required perform the joining process by brazing. Whenever possible, blind or concealed joints shall be used and all joints shall be ground, buffed, and polished to minimize color differences.

C. Mill all joints to a tight hairline fit. Where right angles or tight radius corners are indicated, provide prefabricated members.

D. Complete the cutting, fitting, forming, drilling and grinding of all metal work prior to cleaning and finishing. Remove arises from cut edges and ease edges and corners.

E. Maintain continuity of line and accurate relation of planes and angles. Provide secure attachment and support at mechanical joints, with hairline fit of contacting members.

F. Separate aluminum from dissimilar metals with bituminous paint or preformed separators which will prevent corrosion.

3.2 INSTALLATION:

A. Install work with a minimum of field cutting and drilling. Set the work accurately in location, alignment and elevation, plumb and true to levels and curvatures measured from established lines and levels.
   1. Maximum variation from plumb, level or designated position: 1/8" in 10 feet, not to exceed 1/4" in a total run.
   2. Maximum offset in alignment between two consecutive members in line, end to end: 1/16".
   3. Maximum offset between framing members at corners: 1/32".

B. Form tight hairline joints at all field connections. Where cutting, grinding or brazing is required for proper fit and jointing of the work, restore finishes to eliminate any evidence of such work. Do not cut or abrade finishes which cannot be completely restored in the field. Return items with such finishes to the shop for required alterations followed by complete refinishing or provide new units at Contractor's option.

C. Protect aluminum in contact with concrete, steel and other dissimilar materials with isolating gaskets of bituminous coating.

D. Fixing of fascias and soffits shall be accomplished with concealed fasteners or adhesives approved by the metal fabricator.

3.3 CLEANING AND PROTECTION:

A. Contractor shall correct damaged work to meet finish requirements found elsewhere in the Specifications.

END OF SECTION

SECTION 10 7500

FLAGPOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum Flagpoles.

1.2 RELATED REQUIREMENTS

A. Section 03 3000: Concrete base and foundation construction.

1.3 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; American Association of State Highway and Transportation Officials; 2003.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.

D. NAAMM FP 1001-97 - Guide Specifications for Design of Metal Flagpoles.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to NAAMM FP 1001-97, "Guide Specifications for Design of Metal Flagpoles" or to specified wind speed, whichever is more stringent.

B. Base flagpole design on maximum standard size nylon flag suitable for use with pole.

1.5 SUBMITTALS

A. Product Data: Provide data on pole, accessories, and configurations.

B. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flagpoles:
   1. American Flagpole: www.americanflagpole.com.
   2. Concord Industries, Inc: www.concordindustries.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FLAGPOLES

A. Flagpoles: Aluminum.
   1. Design: Straight shaft.
   2. Mounting: Ground mounted type.
   3. Nominal Height: (2) at 40 ft and (1) at 45 feet; measured from nominal ground elevation.
   4. Mounting: Ground mounted type.
   5. Design: Cone tapered.
   6. Halyard: Interior type.

B. Performance Requirements:
   1. Flagpole With Flag Flying: Resistant without permanent deformation to 90 miles/hr wind velocity; non-resonant, safety design factor of 2.5.

2.3 POLE MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.4 ACCESSORIES

A. Finial Ball: Aluminum gold anodized, 6 inch diameter or size to match pole butt diameter..

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Internal Halyard, Winch System: 1/8 inch stainless steel aircraft cable with plastic coated counterweight and beaded sling assembly. Manually operated mechanical winch having automatic brake system and operated with a removable hand crank. Winch shall be concealed inside the flagpole behind a flush access door having a cylinder lock and continuous piano hinge.

D. Halyard Flag Snaps: Provide 2 swivel snap hooks per halyard, chrome plated bronze.

E. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.

F. Collar: Manufacturer's standard spun aluminum flash collar to match flagpole.

2.5 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36M, corrugated minimum 16 gage steel, galvanized, sized to suit flagpole and installation. Provide with 3/16 inch steel bottom plate and steel centering wedges all welded together. Furnish with 3/16 inch support plate, 3/4 inch diameter x 18 inch long steel ground (lightning) spike, all welded construction..

2.6 FINISHING

A. Aluminum: Clear anodized.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

A. Excavation: For foundations, excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.

B. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure forms, foundation tube, or anchor bolts in position, braced to prevent displacement during concreting.

C. Place concrete immediately after mixing. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than 7 days or use a non-staining curing compound.

D. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks and uniform in texture and appearance. Provide positive slope for water runoff to base perimeter

3.3 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

B. Foundation-Tube Installation: Install flagpole in foundation tube, seated on bottom plate between steel centering wedges. Plumb flagpole and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2 inch layer of elastomeric sealant and cover with flashing collar.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.5 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 11 1200

PARKING CONTROL EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Parking gate access and exit devices, controllers, and barriers.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors and components to be embedded in concrete.

B. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate plan layout of equipment access lanes, mounting bolt dimensions, conduit and outlet locations, power requirements, and wiring diagrams.

C. Product Data: Provide data on operating equipment, characteristics and limitations, operating temperature ranges.

D. Operation Data: Provide operating data for the operating equipment.

E. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.5 PROJECT CONDITIONS

A. Coordinate the placement of equipment frames and anchors.

B. Coordinate the placement of conduit and accessories and the power wiring to operating equipment.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for operating equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Parking Control Equipment:
   1. Door King; Product 1602.
   2. Substitutions: Not permitted.

2.2 MATERIALS

A. Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.3 GATE ARM AND SUPPORT

A. Gate Arm: Aluminum, one piece, external counterbalance, with safety rubber bottom edge,with automatic arm reversing switch. Provide break line in arm.
   1. Truck Entry: Arm length 16 feet.

B. Finish: Two coat enamel with reflective black and yellow diagonal stripes both sides of arm.

C. Arm Clamp: Cast metal, quick change clamp and hub bracket, to permit rapid replacement of arm without fitting or drilling.

D. Provide automatic instant reversing mechanism that stops downward motion of the gate if the arm strikes an object, and returning the arm immediately to the upward position.

2.4 AUTOMATIC GATE

A. Cabinet: 0.075 inch steel cabinet, weather tight seams; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, weather tight gaskets, master keyed locks. Conceal mounting bolts inside units.

B. Arm Control: Mechanism to raise and lower arm by instant reversing electric motor, enclosed speed reducer operated by self contained, plug-in replaceable controller. Design mechanism with slip clutch to prevent breakage if arm is forced, and to permit manual operation if required. Arm movement to stop and start at reduced speed. Components of cadmium coated steel.

C. Electrical Components: Self-contained, plug-in, replaceable components. Include wiring for control units, zinc plated connection box, grounded convenience outlet, switch for automatic or manual operation, switch to disconnect power unit, thermostatically controlled minimum 500 Watt heater strip, and thermal protection disconnect for motor.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. Model 1602 - 1 HP, 115V.

B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

C. Disconnect Switch: Factory mount disconnect switch in control panel.

2.6 CONTROLS

A. Truck Entry: A push-button control shall be provided within the adjacent guardhouse to control the opening of the arm.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that anchor bolts and concrete pad are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric connections are correctly located and of the correct characteristics.

3.2 INSTALLATION

A. Install parking control system and components in accordance with manufacturer's

instructions.

B. Cut grooves in pavement surface, install vehicle detection loops and lead-in wires, and fill grooves with loop filler.

C. Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components required.

3.3 ADJUSTING

A. Adjust system components for smooth operation.

END OF SECTION

SECTION 11 1300

LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power Assisted Dock Leveler.

B. Dock Seal.

C. Dock Bumper.

D. Dock Light.

E. Wheel Chock.

F. Track Guard.

1.2 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Placement of leveler frame into concrete loading dock.

B. Section 03 3000 - Cast-in-Place Concrete: Concrete pit.

C. Section 05500 - Miscellaneous Metals: Dock edge angles

D. Division 16 - Electrical: Power wiring and control wiring conduits for dock equipment.

1.3 SUBMITTALS

A. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit.

B. Shop Drawings: Indicate required opening dimensions, tolerances of opening dimensions, perimeter conditions of construction.

C. Operation Data: Provide operating instructions, identify unit limitations.

D. Maintenance Data: Provide unit maintenance information, lubrication cycles, spare parts manual.

1.4 WARRANTY

A. Lifting system to be warranted for five years parts and labor, and include all fittings, seals, motor, and air bag. All lifting system components to be free from defects in material and workmanship for a period of five years from date of installation.

B. Lip hinge to carry a lifetime structural parts and labor warranty.

C. Structure (deck section, subframe, lip section, rear hinge, front hinge) shall carry a 10 year non-prorated structural parts and labor warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Serco Company. Contact Steve Burke, sburke@justriteequip.com, (215) 918-1030.

2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 POWER ASSISTED DOCK LEVELER

A. Description:
   1. Product: Model AB, air powered recessed dock leveler.
   2. Deck Size: Nominal 7 feet wide x 8 feet long.
   3. Operating Range: 12 inches above dock level, 12 inches below dock level. Provide an operating range above the platform level of sufficient height to enable the lip to extend and clear the truck bed before contact.
   4. Capacity: 45,000 lbs. in accordance with ANSI MH14.1-1987.
   5. Lifting System: Ramp powered by low-pressure system, driven by a two-stage 10 amp fan motor which directs air into bag subassembly and lifts ramp and lip assembly. Housing to be easy access with re-usable and self-cleaning air filter. System to be activated by push-button and include automatic gravity activated lip extension.
   6. Free Fall Protection: Dock leveler to include airDefense support leg system to provide free fall protection in the event of trailer premature departure.
   7. Automatic Vertical Compensation: Floating travel of the ramp with lip extended and resting on the truck bed shall compensate automatically for upward or downward movement of the truck bed during loading and unloading.
   8. Automatic Lateral Compensation: Tilting of the ramp with lip extended and resting on the truck bed shall compensate automatically for canted truck beds of up to 4 inches over the width of the ramp
   9. Lip Operation: Provide the manufacturer's standard mechanism that automatically extends and supports the hinged lip on the ramp edge with the lip resting on the truck bed over the dock leveler's working range, allows the lip to yield under impact of the incoming truck, and automatically retracts the lip when the truck departs.
      a. Lip length shall be 16 inches.
   10. Accessories:
      a. Night locks.
      b. Safety stops.
      c. Toe guards integral for full operating range, painted safety yellow.
      d. Side and rear brush weatherseals.
      e. Safety Strut: Integral, permanently attached to unit.

2.3 COMMUNICATIONS SYSTEM:

A. Manufacturer:DL Manufacturing
   1. Equal to DL Manufacturing, Model 554.
   2. Substitutions as provided under Section 01600.

B. Safety Communications System:
   1. Inside instruction placard and flashing red and green LED lights. Outside caution sign with instructions for truck driver, and flashing red and green LED lights.
   2. Control panel also powers dock light, dock fan, and interlocks with dock door and leveler.

2.4 DOCK SEALS:

A. Acceptable Manufacturers:
   1. Serco S-700. Contact Steve Burke, sburke@justriteequip.com, (215) 918-1030.
   2. Substitutions as provided under provisions of Section 01600.

B. Description:
   1. Type: foam-fit pad type with adjustable head curtain above side pads.
   2. Head: 24" high, adjustable with 12" splits with velcro and pull rope assembly. Provide armor pleating at each end of the head curtain.
   3. Side Pad: Beveled side pads, 6" width at rear and 14" width at front. Provide 4" wide guide stripes

4. Projection of Head and Side Pads: 10".
5. Fabric: Base fabric 40 oz vinyl with overlapping 40 oz. vinyl pleating with 8" exposure.

2.5 DOCK BUMPERS

A. Bumpers: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position with two galvanized steel rods with threaded ends, washers and nuts; between 3 x 2-1/2 x 1/4 inch galvanized steel angle end plates:
   1. Projection From Wall: 4 inches.
   2. With Dock Leveler: 14 inch high x 10 long.
   3. Location: All dock doors.

2.6 TRACK GUARDS

A. Acceptable Manufacturers:
   1. Torbeck Industries: Trak Armor.
   2. Substitutions as provided under Section 01600.

B. Description: "Z" shape door track protector made from ¼ inch thick steel shapes with wall and floor mounting flange.
   1. Height: 4 feet.
   2. Color: Prefinished safety yellow enamel coating.

2.7 DOCK LIGHTS

A. Acceptable Manufacturers:
   1. D.L. Manufacturing: Versa Light model #450.
   2. No Substitutions.

B. Description: Dock light with LEDlight head bulb. Unit complete with step down transformer and internal air flow. Light housing on 42" flexible tubing.

2.8 DOCK FANS

A. Acceptable Manufacturers:
   1. D.L. Manufacturing: AeroTec model #700.
   2. No Substitutions.

B. Description: High velocity blower on pivoting swing arm. 1/3 HP, split capacitor motor with thermal cutout to prevent overheating. Includes 8 foot power cord.

2.9 WHEEL CHOCKS:

A. Description: Laminated rubber sections in a triangular pad with curved contact face, compressed between 1/4" thick steel plates, held by steel bolts. Provide 20 foot long chain and mounting device to dock wall.

B. Location: One per truck dock door.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough-in openings are acceptable.

3.2 PREPARATION

A. Provide pit frame and integral anchors, rough-in sizes and templates for placement by Section 03100.

3.3 INSTALLATION

A. Install dock leveler unit in prepared opening in accordance with manufacturer's instructions.

B. Set square and level.

C. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.

D. Adjust installed unit for smooth and balanced operation.

3.4 DOCK SEALS:

A. Preparation:
   1. Verify wall openings are sized and aligned to tolerances.
   2. Verify required anchors will fit and are compatible with sized and openings.

B. Erection:
   1. Erect door seals in accordance with manufacturer's instructions and shop drawings.
   2. Attach anchors and fittings to prepared wall construction and opening frame.
   3. Use galvanized fasteners permitting site adjustment and alignment.

3.5 WHEEL CHOCKS:

A. Installation:
   1. Install wheel chocks in accordance with manufacturer's instruction.
   2. Secure to concrete foundation wall with expansion bolts or as recommended by manufacturer.

3.6 ADJUSTING

A. Adjust installed unit for smooth and balanced operation.

END OF SECTION

SECTION 12 2113

HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Horizontal slat louver blinds at all exterior glazed areas unless indicated otherwise.

B. Operating hardware.

1.2 RELATED REQUIREMENTS

1.3 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating physical and dimensional characteristics.

C. Samples: Submit two samples, 4 inch long illustrating slat materials and finish, color, cord type and color.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Horizontal Louver Blinds:
   1. Levolor Contract; Product Riviera Classic: www.levolorcontract.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 BLINDS AND BLIND COMPONENTS

A. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by cord; complying with WCMA A100.1.
   1. Maximum Length: 8 feet.

B. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
   1. Width: 1 inch.
   2. Thickness: 0.008 inch.
   3. Color: As selected.

C. Slat Support: Woven polypropylene cord, ladder configuration.

D. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats

E. Bottom Rail: Pre-finished, formed aluminum with top side shaped to match slat curvature; with end caps. Color: Same as headrail.

F. Lift Cord: Braided nylon; continuous loop.

G. Control Wand: Extruded hollow plastic; square shape.

H. Headrail Attachment: Wall brackets.

I. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

A. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

3.2 INSTALLATION TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

3.3 ADJUSTING

A. Adjust blinds for smooth operation.

3.4 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 21 1313

WET PIPE FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
   1. Wet pipe sprinkler systems
   2. Underground fire service mains
   3. System design, installation, testing, and certification

B. Work not covered by this Section:
   1. Installation of portable fire extinguishers
   2. The wiring and monitoring of alarm switches and supervisory signaling system - (To be coordinated with the General Contractor)
   3. All electrical installations - (To be coordinated with the General Contractor)
   4. Fire pumps
   5. Pump room, including all electrical, lighting, plumbing, heating/ventilation and other structural or environmental requirements - (To be coordinated with the General Contractor)
   6. Pump pads – (To be coordinated with the General Contractor)

1.2 RELATED SECTIONS

A. Section 21 3116 Diesel Drive, Centrifugal Fire Pump

B. Section 28 3100 Fire Alarm Signaling System

C. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

D. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed and/or Factory Mutual (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the private underground fire service mains and/or fire sprinkler system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner’s minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of Georgia
1. 2006 International Building Code with Georgia Amendments
2. 2006 International Fire Code with Georgia Amendments
3. Rules and Regulations of the Safety Fire Commissioner Chapter 120-3-3 Rules and Regulations for the State Minimum Fire Safety Standards (Effective 03/09/2010)

B. National Fire Protection Association (NFPA)
1. NFPA 13 (2010) - Installation of Sprinkler Systems
2. NFPA 20 (2003) - Installation of Stationary Fire Pumps
3. NFPA 24 (2002) - Private Fire Service Mains and Their Appurtenances
4. NFPA 70 (2005) - National Electrical Code
5. NFPA 72 (2002) - National Fire Alarm Code
6. NFPA 1963 (2003) - Fire Hose Connections

C. Underwriters Laboratories, Inc. (UL)
1. Fire Protection Equipment Directory (most current edition including supplements)
2. Building Materials Directory (most current edition including supplements)
3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
1. Factory Mutual Research Approval Guide (most current edition including supplements)
2. Property Loss Prevention Data Sheet 2-0 (most current edition) – Installation Guidelines for Automatic Sprinklers

E. American National Standards Institute (ANSI)
1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose
2. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
3. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300
4. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250
5. ANSI/ASME B16.5 - Steel Pipe Flanges and Flanged Fittings
6. ANSI/ASME B16.9 - Factory-made Wrought Steel Buttweld Fittings
7. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welded and Threaded
8. ANSI/ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
9. ANSI/ASME B16.25 - Buttwelded Ends for Pipe, Valves, Flanges, and Fittings
10. ANSI/ASME B36.10M - Wrought Steel Pipe

F. American Society for Testing and Materials (ASTM)
1. ASTM A53 - Welded and Seamless Steel Pipe
2. ASTM A126 - Gray Iron Castings for Valves, Flanges, Pipe Fittings

3. ASTM A135 - Electric-Resistance-Welded Steel Pipe
4. ASTM A183 - Carbon Steel Track Bolts and Nuts
5. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
6. ASTM A194 - Carbon and Alloy Steel Nuts and Bolts for High Pressure and High-Temperature Service
7. ASTM A197 - Cupola Malleable Iron
8. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
9. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
10. ASTM F436 - Hardened Steel Washers
11. ASTM A536 - Ductile Iron Castings

G. American Welding Society (AWS)
1. WS D10.9 - Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

H. American Water Works Association (AWWA)
1. AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
2. AWWA C110 - Ductile Iron and Gray Iron Fittings, 3 in. through 48 in., for Water and Other Liquids
3. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
4. AWWA C115 - Flanged Ductile Iron Pipe and Threaded Flanges
5. AWWA C150 - Thickness Design of Ductile Iron Pipe
6. AWWA C151 - Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
7. AWWA C153 - Ductile Iron Compact Fittings, 3 in. through 12 in., for Water and Other Liquids
8. AWWA C502 - Dry-Barrel Fire Hydrants
9. AWWA C509 - Resilient-Seated Gate Valves for Water and Sewerage Systems
10. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances
11. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 12 in., for Water

1.7 SYSTEM DESCRIPTION

A. Underground Fire Service Mains
1. Fire service water mains shall be provided and installed as indicated on the fire protection drawings and civil utility drawings and in accordance with this specification.
2. Where underground mains pass through building walls, or require a vertical rise or drop, the pipe shall be cement-lined ductile iron unless specifically noted otherwise. Fire pump stub-in from 1 foot above the finished floor to 5 feet outside the exterior wall shall be cement-lined ductile iron. All other piping shall be as specified by the civil engineer.
3. Fire hydrants shall be provided and installed as indicated on the fire protection drawings and civil utility drawings. The connection of each private hydrant to the fire main shall have a nominal diameter of 6 in. and shall include an underground gate valve equipped with a grade box.
4. The top of all underground mains shall have a minimum depth of cover below earth grade as required by local building codes, or NFPA 24, whichever is greater.
5. Underground mains shall be mechanically restrained or have concrete thrust blocks installed at all changes in direction, behind tees, hydrants and dead end lines or capped tees. Thrust restraint systems shall be in accordance with NFPA 24. Mechanical joint restraints and/or thrust blocks shall be designed to

independently resist the thrust forces developed. The design of each thrust restraint system shall be based upon the soil resistance determined by the Soils Engineer for a minimum internal static pressure of 200 psi using a 1.5 safety factor. All stub-ins shall be mechanically restrained and have concrete thrust blocks.

6. All rods, nuts, bolts and washers shall be coated with an acceptable corrosion-retarding material. Corrosion protection shall meet the requirements of NFPA 24.
7. Guard posts shall be provided around all aboveground fire sprinkler system components subject to vehicular damage, including, but not limited to, on-site hydrants, post indicator valves, and freestanding fire department connections. The posts shall be a minimum of 6-in. Schedule 40 pipe filled with concrete. The top of each post shall be 4 ft. above grade level and shall extend a minimum of 3 ft. below grade. Posts shall be anchored in concrete. A minimum clear space of 3 ft. shall be maintained between each post and the component being protected.

B. Sprinkler Systems
1. Sprinkler system designs for the facility shall be in accordance with the Sprinkler Design Schedule on the fire protection drawings.
2. Sprinkler system zones protecting the warehouse area shall not exceed 40,000 sq. ft.
3. Sprinkler system piping within the warehouse area, with the sole exception of sprinkler system risers, shall be installed so that no part of any feed mains, cross mains, or branch lines is located lower than the minimum clear height specified by the Architect and as indicated on the contract documents.
4. Each system riser shall be equipped with a control valve, riser check valve, waterflow switch, pressure gauges (one each installed above and below the clapper of the riser check valve), and main drain.
5. Each riser manifold shall include a minimum 8-in. grooved end cap to facilitate the flushing of the underground lead-ins.

C. Hydraulic Design Requirements
1. Sprinkler Discharge Area: The size, shape, and location of the discharge area for each system shall be as defined in NFPA 13 or FMDS 2-0.
2. The hydraulic design of ESFR sprinkler systems shall consider two additional flowing sprinklers to account for additional sprinklers installed beneath current or future conveyors or other obstructions. Where obstructions are known (e.g., make-up air units, current conveyors, etc.), the flow for the additional sprinklers shall be applied as designed; where the obstructions are not known, the flow for two additional sprinklers shall be applied at the remote end of the near cross main. In all cases, each system must be proved for both known and unknown obstruction conditions, as conditions dictate.
3. Friction Losses: Losses in pipe shall be calculated in accordance with the Hazen-Williams formula with "C" values in accordance with NFPA 13.
4. Hose Stream Allowances: Include an allowance for hose streams as required by NFPA 13 and as indicated on the Sprinkler Design Schedule. Inside hose stream allowances shall be taken at the base of the riser. Outside hose stream allowances shall be taken at the nearest hydrant.
5. The water supply to be utilized for hydraulic calculation purposes shall be as indicated on the fire protection drawings.
6. The effective point for the water supply shall be as indicated on the fire protection drawings.
7. A minimum 10 psi cushion or safety margin between the available water supply residual pressure and the calculated system demand pressure shall be incorporated into all hydraulic calculations.

D. Location of Sprinklers

Location of sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13, FM Data Sheet 2-0, and the listing of each sprinkler. The spacing of sprinklers on the branch lines for open areas shall be essentially uniform.

E. Alarm and Supervisory Devices

1. Provide and install the following alarm and supervisory switches that shall be connected to the building fire alarm control panel (FACP) by the fire alarm contractor.
    a. Tamper Switches: All valves directly controlling water to fire sprinklers, including the backflow prevention device, shall be provided with tamper supervisory devices. An off-normal signal shall be initiated during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position, whichever is less. Each tamper switch shall initiate a distinct supervisory indication. Underground key operated valves are exempt from this requirement.
    b. Waterflow Switches: Each wet-pipe sprinkler system shall be provided with a vane-type waterflow device. Waterflow signals shall be priority signals that shall identify the flow device that is activated.

F. Drain pipes and valves shall be installed on each system to allow drainage. Each system shall drain to the maximum extent possible through the main drain valve. Discharge from drain pipes shall be to the building exterior, directed away from the building and stairs. The discharge from each drain pipe shall be piped to within 8 in. of grade. Concrete splash blocks under each drain outlet shall be provided where necessary to prevent soil erosion.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Drawings

1. Prepare and submit an electronic set (in PDF format) of detailed shop drawings indicating the proposed layout of equipment (including fire pump room, as applicable), fire service mains, risers, hangers, pipes and sprinklers. Shop drawings shall clearly indicate the locations and dimensions (to scale) of all potential obstructions or other interference to the ESFR sprinkler systems, including (but not limited to): bar joists, bottom chord bridging, x-bracing, lighting fixtures, ceiling fans, duct work, roof-top exhaust fans, HVLV fans, etc.
2. Prepare working drawings at a scale not less than 3/32 in. = 1 ft., on sheets not smaller than 24 in. x 36 in., in accordance with all requirements for "Working Drawings (Plans)" as specified in NFPA 13 and NFPA 24. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.
3. A complete set of one-half scale shop drawings shall be submitted to the Engineer upon final approval and prior to the Engineer’s first site review.

B. Product Data

Submit an electronic set of descriptive data (in PDF format) annotated to show the specific model, type, and size of each item proposed. Full descriptive data shall be submitted for all components essential to proper installation, including, but not limited to: sprinklers, pipe, fittings, gate valves, butterfly valves, check valves, hangers, flow switches, tamper switches, pumps, indicator posts, underground pipe, devices, materials and associated equipment. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.

C. Hydraulic Calculations
1. Prepare and submit an electronic set of hydraulic calculations in PDF format. A separate hydraulic calculation must be submitted for each sprinkler system. Nodes or reference points must be clearly identified on the shop drawings. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.
2. At a minimum, hydraulic calculations shall include the following: cover sheet, water supply data, aggregate flow data, node data including elevations, pressures, K-factors, and discharges, fittings table of equivalent lengths used in the calculation, node-to-node hydraulic calculation data, flow diagrams, and pressure/flow curves.

D. Submittals to the Authorities Having Jurisdiction

Submit shop drawings, product data, and hydraulic calculations directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities' field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

E. Project Record Documents
1. Sprinkler Contractor's Superintendent shall prepare, on a daily basis, redlined shop drawings to record as-built conditions. Submit completed redline drawings to the Engineer at project completion.
2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on electronic media (CD or DVD) in PDF and AutoCAD formats.

F. Operation and Maintenance Data

Furnish two (2) sets of instruction manuals containing complete operation and maintenance instructions for the specific make and model of all check valves, control valves, waterflow and pressure switches, valve supervisory switches and other components supplied. Include maintenance data relative to components of system, servicing requirements, inspection data, replacement part numbers and availability, and location and numbers of service depot.

G. Contractor's Material and Test Certificates

Upon completion of required testing, submit completed and signed Contractor's Material and Test Certificates, for aboveground and underground piping, certifying systems meet or exceed the specified requirements.

1.9 QUALITY ASSURANCE

A. Qualifications
1. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of sprinkler systems. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
2. Contractor shall be a firm specializing in performing work of this Section with a minimum of three years experience and must be regularly engaged in making such installations.

3. Contractor shall have successfully installed automatic fire sprinkler systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The Contractor shall submit a copy of a valid state sprinkler contractor certificate and license, as applicable.
4. Contractor shall provide workers normally employed in the field and as otherwise specified in NFPA 13 and local ordinances.
5. All material shall be new and in good condition, free of defects, scratches, corrosion and contamination. Used equipment shall not be permitted.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-listed and FM-approved.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13 and NFPA 24, to other applicable NFPA standards, to all Local, State and Federal codes, and to all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, product data, and hydraulic calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal’s office.
3. Deviations from the contract documents and the contractor's approved submittal documents will not be permitted without written consent from the Engineer.
4. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 13, FM Data Sheet 2-0, Local, State, or Federal requirements, and the requirements of the Authorities Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place. Maintain in place until installation.

B. Provide temporary protective coating on cast iron and steel valves.

1.11 SEQUENCING

A. Flushing of the underground mains and lead-ins must be completed in accordance with the requirements of NFPA 20 and 24 and underground notes on the fire protection drawings before connection is made to aboveground sprinkler or fire pump piping.

1.12 GUARANTEE

A. The Contractor, in addition to other warranties or guarantees required by the contract documents, shall guarantee workmanship on all piping, devices, and related materials for a period of one year from the date of the Engineer’s final acceptance of the work. All defects shall be promptly corrected at no cost to the Owner.

B. The Contractor is responsible for providing a system that has been coordinated with the contract documents and approved by all concerns referenced in this document including, but not limited to, the Owner, local authorities, and the Owner's representatives.

1.13 EXTRA MATERIALS

A. Provide spare sprinklers in accordance with the provisions of NFPA 13. The quantity of each type of extra sprinkler shall be as specified in NFPA 13, except that 24 spare ESFR sprinkler shall be provided.

B. Provide manufacturer's sprinkler wrenches in each metal sprinkler cabinet for each type of sprinkler stored in the box.

C. Provide metal cabinets for storage of spare sprinklers and sprinkler wrenches. Cabinets shall be of sufficient size to permit spare sprinklers to fit upright and reasonably secured within the sockets of the cabinets; spare sprinklers shall not be laid on their sides within the cabinets. Cabinets shall be located within the fire pump room, unless otherwise indicated.

1.14 HYDRAULIC DESIGN INFORMATION SIGN

A. Provide a permanently marked, weatherproof metal or rigid plastic sign, with the following information inscribed thereon:
   1. Location of the design area or areas
   2. Discharge densities over the design area or areas, or number and discharge pressure of calculated sprinklers, as applicable
   3. Required flow and residual pressure demand at the base of the riser
   4. Occupancy classification or commodity classification and maximum permitted storage height and configuration
   5. Hose stream demand included in addition to the sprinkler demand

B. The lettering on the sign shall be engraved or otherwise typeset. Handwritten signs shall not be accepted.

C. Signs shall be permanently secured to the system riser with corrosion resistant wire, chain, or other approved means.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment supplied under this specification shall be new and shall be UL-listed or FM-approved for fire protection service and installed and used as intended by the listing.

2.2 UNDERGROUND FIRE SERVICE MAINS

A. Underground pipe shall be FM-approved for fire protection service and shall be ductile iron pipe meeting AWWA C150 and C151, cement-mortar lined per AWWA C104, and laid per AWWA C600, or PVC piping meeting C900 and laid per C605.

B. The pressure class of the pipe, joints, fittings, valves and hydrants shall not be less than the maximum working pressure of the system under non-emergency (no-flow) conditions, with the fire pump running. In no case shall the pressure class be less than 175 psi.

C. Ductile iron pipe shall be joined by mechanical or push-on joints meeting AWWA C111, cast iron flanges meeting ANSI B16.1, ductile iron flanges meeting AWWA C115, or other approved means.

D. Fittings shall be cast iron meeting ANSI B16.1 or ductile iron meeting AWWA C110.

E. Fire hydrants shall be dry-barrel, high-pressure type, meeting the requirements of the local jurisdiction.

F. Underground sectional valves shall be AWWA NRS gate valves equipped with the mounting flange for indicator posts.

2.3 ABOVEGROUND PIPING SYSTEMS

A. Sprinkler pipe shall be per NFPA 13, and shall be steel conforming to ASTM A-53, A-135, or A-795. Piping joined by welding or rolled-groove methods shall have a minimum nominal wall thickness in accordance with Schedule 10 for sizes less than 6 in. (150 mm), 0.134 in. (3.40 mm) for 6 in. (150 mm), and 0.188 in. (4.78 mm) for 8 and 10 in. (200 and 250 mm). Piping joined by threaded methods shall be Schedule 40 for sizes less than 8 in. (200 mm) and Schedule 30 for sizes 8 in. (200 mm) and larger. Wall thicknesses less than those described above may be used if the pipe is specifically listed for fire sprinkler service and carries a UL Corrosion Resistance Ratio of at least 1.0, including when joined.

B. Pipe shall be joined by threaded, rolled-groove, welded or flanged methods. Welding methods shall comply with all requirements of AWS D10.9, threads shall be cut to ANSI/ASME B 1.20.1, and groove dimensions shall be compatible with the listings of the couplings and fittings used. Flange gaskets shall be red rubber sheet, 1/16 in. thick, conforming to ASTM D-2000. Gaskets for grooved couplings shall be EPDM, grade E type A, conforming to ASTM D-2000.

C. Grooved couplings and fittings shall be of the same manufacturer.

D. Fittings shall be cast iron conforming to ANSI B16.1 or ANSI B16.4, malleable iron conforming to ANSI B16.3, or steel conforming to ANSI B16.5, ANSI B16.9, ANSI B16.11, ANSI B16.25, or ASTM A234.

E. Where changes in pipe diameters occur or are required, only tapered fittings (e.g., reducing tees, concentric reducers) shall be used. Reducing couplings shall not be utilized.

2.4 SPRINKLERS

A. Sprinkler selection for each hazard area shall be in accordance with the Sprinkler Design Schedule indicated on the fire protection drawings.

B. Upright and pendent sprinklers in unfinished areas shall have natural brass finish.

C. Pendent sprinklers in all finished areas shall be recessed or semi-recessed type with a chrome finish, unless otherwise noted on the drawings.

2.5 PIPING SPECIALTIES

A. Wet-pipe Sprinkler Riser Valve: Provide Viking Easy Riser Swing Check Valve or equivalent, equipped with 2-in. main drain valve piped to exterior, and inlet and outlet pressure gauges for each individual sprinkler system.

B. Waterflow Indicators: Provide vane-type waterflow switches at each individual wet-pipe sprinkler system supply. Switch shall have sensitivity setting to signal any flow of water that equals or exceeds the discharge from the smallest sprinkler installed on the system. Waterflow switch mechanisms shall incorporate an instantly recycling, adjustable retard element, adjustable up to two minutes, which shall be set between 20 and 40 seconds. Switches shall be rated at 175 psi cold water pressure. Switches shall be compatible with the fire alarm system and NFPA 72.

C. Valve Supervisory Switches: Provide sprinkler control valves with approved supervisory (tamper) switches. The switch shall be designed to transmit a supervisory signal to the building fire alarm system. The supervisory signal shall be obtained during the first two revolutions of the hand wheel or operating crank. The switch shall not interfere with the operation of the valve, nor obstruct the view of its indicator. The trouble signal shall be obtained during abnormal interconnecting circuit conditions. Devices shall be compatible with the fire alarm system and the requirements of NFPA 72. All switches shall be suitable for installation of end-of-line devices. Switch shall incorporate tamper-resistant features.

D. Pressure Gauges: Pressure gauges shall be the Bourdon-tube type with a metal corrosion-resistant case, flat glass window, 3½-in. diameter white background dial with black markings, and a 0-300 psig range. Gauge accuracy shall be 3-2-3% of full range. A shutoff valve shall be provided with each gauge connection.

2.6 VALVES

A. Provide valves as required by NFPA 13 and of types approved for fire protection system service. Valves 2 in. and smaller shall be bronze. Unless otherwise specified, valves 2½ in. and larger shall be bronze mounted with iron bodies.

B. Gate Valves
1. Up to and including 2 in.: Bronze body, bronze trim, rising stem, handwheel, inside screw, single wedge or disc.
2. Over 2 in.: Iron body, bronze trim, rising stem, handwheel, OS&Y (unless provided with an indicator post), single wedge, resilient-seated.

C. Globe Valves
1. Up to 2 in.: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, with backseating capacity repackable under pressure.
2. Over 2 in.: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, renewable seat and disc.

D. Ball Valves
1. Up to and including 2 in.: Bronze one-piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops.
2. Over 2 in.: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged.

E. Butterfly Valves
1. Bronze body, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch compatible with the fire alarm system.
2. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable EPDM seat, extended neck, handwheel and gear drive and integral indicating device and built-in tamper proof switch compatible with the fire alarm system.

F. Fire Department Hose Valves
1. Brass body, UL-listed/ FM-approved
2. Field adjustable pressure restricting mechanism, rated inlet pressure to 200 psi.

G. Grid Relief Valves
1. Brass Body
2. Field adjustable pressure restricting mechanism, rated inlet pressure to 200 psi.

2.7 PIPE HANGERS

A. Pipe hangers, braces and supports shall be provided in accordance with NFPA 13.

B. Hangers for support of piping and equipment shall be UL-listed and/or FM-approved for fire protection service. Supports, including all-thread rods, shall not interfere with access to operating areas or contact building services equipment.

2.8 PIPE SLEEVES

A. For sleeves in masonry concrete walls, floors, roofs provide ASTM A53, Schedule 40 or standard weight, hot-dip galvanized steel pipe sleeves.

B. For sleeves in partitions, and other than masonry and concrete walls, floors and roofs provide hot-dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per sq.ft.

2.9 PIPE ESCUTCHEON PLATES

A. Provide approved one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed areas. Provide chromium-painted finish on plates in finished areas. Securely anchor plates in place with set screws or other approved means.

2.10 FIRE DEPARTMENT CONNECTION

A. Provide an approved fire department connections with two 2½-in NST inlets as located per the fire protection drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate the work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment, and shall take any necessary measures to keep the premises dry at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Prior to the operation (opening or closing) of any valve controlling water to the domestic or fire system, notification shall be given to, and approval obtained from, the General Contractor.

D. The A/E, Developer and Owner shall NOT be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. The responsibility rests with the Contractor.

E. Ream pipe and tube ends. Remove burrs and fins.

F. Prepare piping connections to equipment with flanges or unions.

G. All excess oil, dirt, pipe joint compound, rust, mill scale, and factory coatings shall be removed from piping and equipment. All dirt, debris and excess cutting oil shall be removed from the interior of all piping and equipment before it is erected.

3.2 INSTALLATION

A. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean. All piping in areas with finished ceilings shall be concealed. All wiring shall be in metal conduit.

B. Inspect, test, and approve piping before covering, or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in pipe sizes through tapered reducing pipe fittings; the use of bushings will not be permitted. Welding shall be performed in the shop; field welding will not be permitted. Conceal piping, fittings, fixtures, hangers and supports in areas with suspended ceilings and finished areas.

C. Install equipment in accordance with manufacturer's instructions.

D. Use proper lubricant on ends of piping or gaskets where required by pipe fitting or coupling manufacturer. The manufacturer's recommended lubricant shall be used.

E. Where required by manufacturer, properly torque bolts to manufacturer's specifications using a torque wrench.

F. All sprinklers shall be installed after the piping has been installed at ceiling level, and not while the piping is on ground level. There shall be no exceptions.

G. Place pipe runs to minimize obstruction to other work.

H. Insulate connection between pipe and fittings, hangers or dissimilar metal against direct contact. Use dielectric insulating flanges and units.

I. Support all sprinkler piping, standpipe risers, etc., as specified in applicable NFPA standards.

J. Provide a grooved end cap fitting at ends of all cross mains and riser manifolds to serve as flushing connections.

K. The Contractor shall install equipment, piping and hangers so that it will not interfere with piping, lighting, electrical conduit and wiring, structural members, air-conditioning equipment, and ceiling construction. If any such interference exists or occurs, the Contractor shall make the necessary adjustment to permit satisfactory installation of the equipment with no additional cost.

L. Sprinkler installation shall be coordinated with the installed mechanical and electrical work and the ceiling grid/layout. Where sprinklers are to be installed on modular ceiling panels (lay-in acoustical tile), sprinklers shall be located in the center of the ceiling panel, or located in other symmetrical pattern acceptable to the Building Owner's Representative and in accordance with referenced standards and design drawings. The Contractor shall furnish additional sprinklers that may be required for coordinated ceiling pattern without additional cost to the Owner, even though number of sprinklers may exceed minimum code requirements.

M. The Contractor shall install the piping and equipment in accordance with approved shop drawings.

N. Main and Auxiliary Drains
   1. Each system shall be furnished with a main drain that is capable of draining the majority of the system. Drains shall discharge to the exterior. Drainage to floor is not permitted.

2. Auxiliary drains shall be provided to drain any sections of piping that trap water, or are not capable of being drained by the main drain in accordance with NFPA 13. Auxiliary drains shall discharge to the exterior to the maximum extent possible and the location shall be approved by the Architect.
3. All drains terminating outside shall be piped to within 8 in. of finished grade. Concrete splash blocks shall be provided at grade level beneath all outside drains to preclude soil erosion where necessary.

O. Install piping to conserve building space, and not interfere with use of space and other work.

P. Group piping whenever practical at common elevations, as permitted by the structural design and the sprinkler layout, without creating obstruction conflicts with ESFR sprinklers.

Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

R. Coordinate location and method of hanging of sprinkler piping 4 in. and larger with the structural design; provide additional structural bracing where necessary. Do not penetrate structural members without the prior written approval of the structural engineer.

S. Tapping or drilling of load-bearing structural members is not permitted. Attachments may be made to steel or concrete structures with approved clamps and hangers designed in accordance with NFPA 13 and local standards.

T. Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Grout sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide clearance between exterior of piping and interior of sleeve in accordance with NFPA 13. Firmly pack space with noncombustible insulation and caulk at both ends of the sleeve with plastic waterproof cement that will dry to a firm but pliable mass, or provide a segmented elastomeric seal. In fire-resistive rated assemblies (walls, floors, ceiling and partitions), pack space with approved firestopping materials. Installation of materials shall result in fire resistance rating equal to or greater than the assembly rating, unless otherwise indicated. Extend sleeves in floor slabs 3 in. above the finished floor.

U. Die cut screw joints with full cut standard taper pipe threads with non-toxic joint compound applied to male threads only.

V. Install valves with stems upright or horizontal as required, not inverted. Remove protective coatings after installation.

W. The Contractor is responsible for coordination of system requirements with all conditions of the building and site including, but not limited to, blind spaces, shelving, lights, grilles and diffusers, piping, duct work, doors, windows, equipment platforms, walls (fire-rated and non-fire-rated), beams, joists, columns, HVAC equipment, electrical panels and equipment, ceilings, areas without ceilings, wall construction, floors and all construction, equipment and building appurtenances. Contractor shall coordinate the layout of equipment, piping and materials to be located within the Pump Room with the General Contractor to assure sufficient space and openings to accommodate the entire installation, and accessibility for maintenance and replacements, if necessary.

X. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

Y. Provisions shall be made by the Contractor to protect piping, sprinklers and other components of the sprinkler systems from exposure to the elements or extreme climatic conditions including freezing and high temperature.

Z. Pipe Hangers:
1. In areas subject to water pressures in excess of 100 psi, provide a hanger, designed to prevent upward pipe movement, within 12 in. of a pendent sprinkler located at the end of a branch-line or on armovers over 12 in. in length in areas with suspended ceilings. All-thread rods longer than 20 ft. supporting armovers or end sprinklers require additional reinforcement to prevent buckling.
2. Hangers shall be positioned such that they are connected to pipe segments only and not to fittings.

AA. Identification signs shall be provided. Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix hydraulic design data nameplates to the riser of each system. Provide signs on the sprinkler control valve of each system. The sign shall identify the area of coverage controlled by the valve.

BB. Provide an inspector's test connection (ITC) for each sprinkler system and locate the ITC on the exterior wall and connected to the hydraulically most remote branch line from each sprinkler system riser or the far cross main or on the riser for each system. All ITC locations shall be approved by the Architect. Each ITC terminating outside shall be piped to within 8 in. of finished grade. Concrete splash blocks shall be provided at grade level beneath each discharge to preclude soil erosion where necessary.

CC. Thrust Blocks
1. The trench in the area of each fitting shall be cut to provide a thrust block bearing surface on undisturbed soil.
2. Concrete shall be poured using forms to fit snugly against as much of the fitting as possible without interfering with access to fitting joints.
3. The concrete shall be allowed a minimum curing time of five days.

3.3 ESFR SPRINKLERS (PENDENT TYPE)

A. The sprinkler contractor shall be responsible for proper consideration of all obstructions and other installed equipment which may have an impact on the operation of ESFR sprinklers.

B. Prior to the start of construction, the sprinkler contractor shall closely coordinate with all other trade, including, but not limited to, structural steel, mechanical, electrical, plumbing, data processing, and material handling to ensure the water discharge from ESFR sprinklers will not be prohibited from reaching burning commodities at high volume and high momentum.

C. The standard to be utilized in identifying ESFR sprinkler placement and obstruction issues shall be the latest version of FM Global Property Loss Prevention Data Sheet 2-0. Any obstruction issue identified during the course of construction or acceptance inspections shall be corrected to meet the requirements of this standard at no additional cost.

D. The following are the most common rules found in the standard for handling obstructions located entirely below the sprinklers. Compliance with these rules in no way relieves the contractor from full compliance with the standard.
1. Individual obstructions measuring ¾-in. wide or less and at least 4 in. below the sprinkler deflector may be ignored.
2. Continuous obstructions wider than ¾ in. and no wider than 1¼ in. shall be located at least 12 in. horizontally from the centerline of the sprinkler or at least 16 in. vertically below the sprinkler deflector.
3. Continuous obstructions wider than 1¼ in. and no wider than 2 in. shall be located at least 12 in. horizontally from the centerline of the sprinkler or at least 24 in. vertically below the sprinkler deflector.

4. Continuous obstructions wider than 2 in. and no wider than 12 in. shall be located at least 12 in. horizontally from the centerline of the sprinkler.
5. Continuous obstructions wider than 12 in. and no wider than 24 in. shall be located at least 24 in. horizontally from the centerline of the sprinkler.
6. Isolated rectangular or round obstructions (such as light fixtures, junction boxes, etc.), in which all dimensions parallel to the floor are no greater than 24 in., shall be located at least 12 in. from the centerline of the sprinkler.

E. Obstructions wider than 24 in. in length and/or width shall be positioned in accordance with Figure 31 of the standard; otherwise additional sprinklers shall be installed underneath the obstruction. If additional sprinklers are installed beneath a continuous obstruction, up to two sprinklers operating at the same pressure as those at the ceiling shall be added to the ceiling demand.

F. Care shall be taken to consider "grouped" continuous obstructions created by running mains too close together or too close to adjacent bar joists or girders. Grouped continuous obstructions shall be treated as a regular continuous obstruction, as described in the preceding paragraphs.

G. The rules noted above assume obstructions are located on one side of the ESFR sprinkler only. All objects on the opposite side of the sprinkler shall be positioned in accordance with figure 31 of the standard.

H. ESFR sprinklers shall be located such that vertical supply ducts from unit heaters are centered between 4 ESFR sprinklers. If vertical duct is not centered, or if the diffuser component measures larger than 24 in. by 24 in., an additional ESFR sprinkler shall be located below the diffuser component. The flow and pressure demand from that additional sprinkler shall be added to the hydraulic demand of the sprinkler system. Where the bottom of the diffuser is not a horizontal plane capable of banking the heat from a fire to the sprinkler, a horizontal barrier that extends to all edges of the diffuser shall be provided and installed above the ESFR sprinkler.

I. The contractor shall space ESFR sprinklers with consideration of the location of all skylights and/or roof vents so that an ESFR sprinkler is not located directly underneath a skylight or roof vent. Refer to architectural drawings for the locations of skylights and roof vents, as applicable.

3.4 INSPECTIONS AND TESTING

A. The system shall be subject to inspection and acceptance by the Engineer and the Authorities Having Jurisdiction for the purpose of determining the system is in accordance with federal, state, local and specification requirements, applicable standards of the NFPA and FM Data Sheets, and other related codes or standards.

B. The Contractor shall be responsible for performing and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification.

C. Inspection and test procedures shall be submitted to the Engineer for approval prior to use.

D. All underground piping shall be completely flushed in accordance with NFPA 24 and NFPA 20 in the presence of the Engineer. Flushing procedures are subject to the approval of the Engineer and the Authorities Having Jurisdiction.

E. All underground piping shall be hydrostatically tested at 225 psi for 2 hours in accordance with NFPA 24 and as indicated on the civil site utility drawing and fire protection drawings. Before testing, the trench shall be backfilled between joints. All joints shall be left exposed during the test.

F. Each hydrant shall be fully opened and closed under full system pressure with the fire pump running and checked for proper drainage.

G. All interior system piping shall be hydrostatically tested at not less than 225 psi for 2 hours in accordance with NFPA 13.

H. All operating parts, including electrical equipment, shall be fully tested to ensure their proper operation. All control valves shall be fully closed and opened under full system pressure, with the fire pump running.

I. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified two weeks in advance of the tests in order to arrange attendance at the tests.

J. The Contractor shall perform supplemental tests and shall render additional services in connection with the sprinkler system, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

~END OF SECTION~

SECTION 21 1317

PREACTION FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
   1. Preaction sprinkler system
   2. System design, installation, and certification

1.2 RELATED SECTIONS

A. Section 28 3100 Fire Alarm Signaling System

B. Section 21 1313 Wet Pipe Fire Sprinkler Systems

C. Unless specifically modified by this section, the requirements of Section 21 1313 shall apply to the design, material/ equipment, installation, and testing of the preaction sprinkler system.

D. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

E. Comply with Division 2, 13, 15, and 16 Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed and/or Factory Mutual (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the private underground fire service mains and/or fire sprinkler system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner’s minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of Georgia
   1. 2006 International Building Code with Georgia Amendments
   2. 2006 International Fire Code with Georgia Amendments
   3. Rules and Regulations of the Safety Fire Commissioner Chapter 120-3-3 Rules and Regulations for the State Minimum Fire Safety Standards (Effective 03/09/2010)

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2010) - Installation of Sprinkler Systems
   2. NFPA 70 (2005) - National Electrical Code
   3. NFPA 72 (2002) - National Fire Alarm Code

C. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
   1. Factory Mutual Research Approval Guide (most current edition including supplements)

1.7 SYSTEM DESCRIPTION

A. Preaction Sprinkler Systems
   1. Provide a double interlock preaction fire sprinkler system to protect the Data Center. The system shall be arranged with independent electric and pneumatic (fully mechanical) interlocks such that water will not be admitted into the system piping unless both the electronic detection system is activated AND supervisory air pressure is lost in the system piping.
   2. Double interlock preaction sprinkler system shall be designed and installed in accordance with the requirements of NFPA 13, the fire protection drawings, and this section.
      a. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping, and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.
   3. Preaction sprinkler system riser and all trim components shall be located as indicated on the drawings.

B. Control System
   1. Control of the double interlock preaction sprinkler system shall be by a UL-Listed Intelligent/Addressable Releasing Control Panel (RCP), as specified in Section 28 3100.
   2. The control system shall meet the requirements of NFPA 72. The control panel and the solenoid valve that activates the water control valves shall be compatible

with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.

3. The detection system shall consist of spot-type photoelectric smoke detectors. Detection shall be located in the Data Center. The layout and spacing shall be in accordance with NFPA 72, equipment and manufacturer's instructions with respect to ceiling height and quantity of airflow in the protected areas.
4. Selection of cable types and wire with respect to conductor size, shielding requirements, and separation between circuits shall be in full compliance with the requirements of the manufacturer of the RCP, without exception. All circuit wire/cable shall be specifically listed for use with fire alarm systems.
5. Power Supply: The primary operating power shall be in accordance with NFPA 72. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and shall not initiate a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Backup power shall be provided through use of rechargeable, sealed, lead acid storage batteries.
6. The RCP shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
7. All subpanels, such as power expanders, shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.

C. System Operational Features
1. The system shall include an automatic fire detection system, manual actuation station, supervisory and alarm switches, and associated equipment. Preaction sprinkler system piping shall be provided with supervisory air pressure not to exceed 40 psig.
2. System Actuation: Activation of any detection device in the Data Center shall actuate alarm zone circuits of the control panel and activation of a second device in the Data Center shall release the electronic interlocks on the corresponding automatic water control valve covering the corresponding sprinkler system.
3. Activation of any detection device or manual actuation station shall cause an alarm signal to be received at the building Fire Alarm Control Panel (FACP).
4. Activation of any sprinkler waterflow pressure-type alarm switch shall cause an alarm condition at the building FACP.
5. Valve tamper and supervisory air pressure signals shall be monitored by the building FACP as supervisory conditions.

D. Location of Sprinklers
1. Location of sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 and the listing of each sprinkler. The spacing of sprinklers on the branch line(s) for open areas shall be essentially uniform.

E. Alarm and Supervisory Devices
1. Provide and install the following alarm and supervisory switches that shall be connected to the FACP by the contractor.
    a. Tamper Switches: All valves directly controlling water to fire sprinklers shall be provided with tamper supervisory devices. Refer to fire protection drawings.
    b. Waterflow Switches: The preaction sprinkler system shall be provided with a pressure-type waterflow device compatible with the fire alarm system and NFPA 72. Waterflow signals shall be priority signals that shall identify the flow device that is activated.
    c. Air Pressure Supervisory Switches: The preaction system shall be provided with a device to monitor the air pressure within the system piping. The device shall initiate a supervisory signal for high and low-pressure conditions.

d. Preaction valve release solenoid: Each preaction valve trim shall be provided with a device to release the electronic portion of the double interlock in accordance with the manufacturer's requirements.

F. Drain pipe and valve shall be installed on the system to allow drainage. The system shall drain to the maximum extent possible through the main drain valve.

G. Preaction System Operating Sequence
1. When the initial detector of the detection system in the Data Center activates, the RCP initiates an alarm signal to the FACP.
2. When the second detector of the detection system in the Data Center activates, the FACP releases the first (electronic) interlock on the deluge (preaction) valve.
3. Simultaneously, a set of contacts provided as an input for the EPO system changes state.
4. When a sprinkler is opened by heat from a fire, air flows out of the open sprinkler, lowering the air pressure in the system. The drop in air pressure causes the release of the second (pneumatic) interlock on the deluge valve.
5. Once both interlocks are released, the deluge valve opens and water flows in the sprinkler piping to the open sprinkler.
6. A waterflow signal shall be generated for transmission via the RCP to the FACP upon waterflow in each system equal to or greater than any one sprinkler.
7. Valve tamper switch activation shall be monitored by the FACP via the RCP.
8. The RCP shall generate a supervisory signal at the FACP when the air pressure in the preaction system distribution piping exceeds or falls below the maximum and minimum allowable air pressures respectively.

H. Work Not Covered by this Section
1. Electrical circuit (110 VAC/ 60 hz) for the air compressor

PART 2 - PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

A. Sprinkler pipe shall be internally galvanized and per NFPA 13, and shall be steel conforming to ASTM A-53, A-135, or A-795. Piping joined by welding or rolled-groove methods shall have a minimum nominal wall thickness in accordance with Schedule 10 for sizes less than 6 in. (150 mm), 0.134 in. (3.40 mm) for 6 in. (150 mm), and 0.188 in. (4.78 mm) for 8 and 10 in. (200 and 250 mm). Piping joined by threaded methods shall be Schedule 40 for sizes less than 8 in. (200 mm) and Schedule 30 for sizes 8 in. (200 mm) and larger. Wall thicknesses less than those described above may be used if the pipe is specifically listed for fire sprinkler service and has a UL Corrosion Resistance Ratio of at least 1.0, including when joined.

2.2 SPRINKLERS

A. Sprinkler selection for the hazard area shall be 5.6 K-factor, ordinary temperature rated, quick response, dry pendent type with concealed escutcheons.

2.3 PREACTION SYSTEM RISER

A. The preaction double interlock system riser shall be a field assembled unit
1. Detection and release shall be provided by a Releasing Control Panel (RCP).
2. Supervisory air shall be provided via a riser mounted air compressor.
3. The detection shall be single zone.
4. The system shall utilize an electric and a pneumatic interlock.

B. Automatic Water Control Valve (Deluge Valve): Automatic water control valve (deluge valve) shall be electrically-actuated and rated for a working pressure of 175 psi. Valve

shall be capable of being reset without opening the valve. Valve shall be of the type that does not require priming water to be properly set.

1. Electrical solenoid valve used to actuate the water control valve shall be an integral component of the valve or shall be approved for use by the water control valve manufacturer. Solenoid valve shall be rated at 24 volts direct current, and shall be normally closed type that operates when energized. Solenoid valves shall be rated for a maximum pressure differential of 175 psi.
2. Water control valve shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset.
3. Assembly shall be field assembled with the valve manufacturer's standard trim piping for double interlock preaction systems, drain and test valves, pressure gauges, and other required appurtenances.
4. Each assembly shall include an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation.
5. Automatic water control valves shall the following or approved equivalent:
   a. Viking Model E-1 Deluge Valve with double interlock (electric/pneumatic) releasing trim

C. Riser Check Valve: Provide riser swing check valve equipped with main drain valve piped to the building exterior, to within 8 inches of grade, and inlet and outlet pressure gauges for each individual sprinkler system.

D. Switch: Low air pressure switch shall detect a 10 psi off normal system air pressure. The switch shall be capable of being mounted in any position in the alarm line trim piping of the preaction valve trim.

E. Valve Supervisory Switches: Provide sprinkler control valves with approved supervisory (tamper) switches. The switch shall be designed to transmit a supervisory signal to the building fire alarm system. The supervisory signal shall be obtained during the first two revolutions of the hand wheel or operating crank. The switch shall not interfere with the operation of the valve, nor obstruct the view of its indicator. The trouble signal shall be obtained during abnormal interconnecting circuit conditions. Devices shall be compatible with the fire alarm system and the requirements of NFPA 72. All switches shall be suitable for installation of end-of-line devices.

F. Pressure Gauges: Pressure gauges shall be the Bourdon-tube type with a metal corrosion-resistant case, flat glass window, 3½-in. diameter white background dial with black markings, and a 0-300 psig range. Gauge accuracy shall be 3-2-3% of full range. A shutoff valve shall be provided with each gauge connection.

2.4 DETECTION SYSTEM

A. Detection for the Data Center preaction system shall be in accordance with Section 28 3100.

B. Complete design information shall be submitted with the sprinkler system shop submittal for review by the fire protection engineer in accordance with the specifications.

2.5 SUPERVISORY AIR SYSTEM

A. Air compressor: Provide an oilless piston-type compressor sized to fill the sprinkler system to the normal operating pressure within 30 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate the exact location for the preaction riser near to the exterior wall. Consider intrusion into the egress corridor when placing the enclosure.

B. The penetration into the Data Center shall be above the entry door so as not to interfere with the other wall mounted panels.

C. Water filled sprinkler pipe(s) above the Data Center shall not be permitted and shall be routed around the room.

3.2 INSPECTIONS AND TESTING

A. An air pressure leakage test at 40 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

B. Detection and Control System
   1. Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. Testing shall be in accordance with NFPA 72. The test shall include the following:
      a. Visual inspection of wiring connections.
      b. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.
      c. Test of each function of the control panel.
      d. Test of each circuit in the normal, open and ground fault modes.
      e. Test of each initiating device in both normal and trouble conditions.
      f. Test of each control circuit and device.
      g. Test of each alarm notification appliance.
      h. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

C. Automatic Water Control Valve
   1. Each water control valve (deluge) shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective detector and a manual actuation station connected to the control panel (if provided) and a manual actuation device that is part of the valve trim. A full-flow main drain test shall be made. For preaction systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.
   2. Test results shall be witnessed and recorded. Test results shall include the number of seconds elapsed between the time the test valve is opened and tripping of the deluge valve, trip-point air pressure of the deluge valve, water pressure prior to valve tripping, and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice.

D. Supervisory Air
   1. Supervisory air pressure shall be reduced from the normal system pressure to the point at which a low-pressure signal is generated. Air pressure shall be restored to verify trouble signal restoration.
   2. Supervisory air pressure shall be increased above the normal system pressure to the point at which a high-pressure signal is generated. Normal air pressure shall be restored to verify trouble signal restoration.
   3. Automatic start/stop features of air compressor shall be tested.

E. All operating parts, including electrical equipment, shall be fully tested to ensure their proper operation. All control valves shall be fully closed and opened under full system pressure, with the fire pump running.

F. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified two weeks in advance of the tests in order to arrange attendance at the tests.

G. The Contractor shall perform supplemental tests and shall render additional services in connection with the sprinkler system, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

3.3 TRAINING SESSIONS

A. Prior to project completion, the Contractor shall provide initial operational training to the Owner's key employees.

B. The Contractor shall arrange finalized training sessions at the convenience of the Owner. The sessions shall be completed as soon as possible following system acceptance. Each training session shall include details of the system interface and control.

~END OF SECTION~

SECTION 21 3116

DIESEL DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
   1. Diesel engine-driven fire pump, electric motor-driven jockey pump, and associated controllers and equipment
   2. System design, installation, and certification

B. Work not covered by this Section
   1. Installation of portable fire extinguishers
   2. The wiring and monitoring of alarm switches and supervisory signaling system – (To be coordinated with the General Contractor)
   3. All electrical installations – (To be coordinated with the General Contractor)
   4. Underground fire service main installation
   5. Water storage (suction) tank
   6. Pump Room, including all electrical, lighting, plumbing, heating/ventilation and other structural or environmental requirements – (To be coordinated with the General Contractor)
   7. Pump pads – (To be coordinated with the General Contractor)

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 28 3100 Fire Alarm Signaling System

C. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

D. Comply with other Divisions and Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 INTENT

A. It is the intent of this specification section to provide the Owner's minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.4 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to

perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.5 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed or Factory Mutual (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, Engineer, insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the fire pump and/or fire sprinkler system subcontractor(s).

1.6 REFERENCES

A. State of Georgia
1. 2006 International Building Code with Georgia Amendments
2. 2006 International Fire Code with Georgia Amendments
3. Rules and Regulations of the Safety Fire Commissioner Chapter 120-3-3 Rules and Regulations for the State Minimum Fire Safety Standards (Effective 03/09/2010)

B. National Fire Protection Association (NFPA)
1. NFPA 13 (2010) - Installation of Sprinkler Systems
2. NFPA 20 (2003) - Installation of Stationary Fire Pumps
3. NFPA 24 (2002) - Private Fire Service Mains and Their Appurtenances
4. NFPA 70 (2005) - National Electrical Code
5. NFPA 72 (2002) - National Fire Alarm Code
6. NFPA 1963 (2003) - Fire Hose Connections

C. Underwriters Laboratories, Inc. (UL)
1. Fire Protection Equipment Directory (most current edition including supplements)
2. Building Materials Directory (most current edition including supplements)
3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
1. Factory Mutual Research Approval Guide (most current edition including supplements)

1.7 SYSTEM DESCRIPTION

A. Fire Pump System:
1. Provide fire pump and associated equipment complete and ready for operation. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 20, NFPA 70, and NFPA 72, except as modified herein.
2. The fire pump and its controller shall be located in the pump room, as indicated on the fire protection drawings. The installation shall include all piping, valves, lighting, heating, ventilation, auxiliaries and appurtenances specified and indicated in NFPA 20.
3. Provide a pressure maintenance (jockey) pump and controller located within the fire pump room.
4. Provide and arrange all pump equipment as generally indicated on the fire protection drawings and in a manner that allows maximum utilization of the space as well as

maximum access to equipment for maintenance and testing purposes. The contractor shall coordinate with other trades as necessary to avoid conflicts.

5. Fire pump and jockey pump shall take suction from a ground-level water storage tank located adjacent to the pump room, as indicated on the drawings.

B. Sprinkler Systems

1. Complete automatic sprinkler protection shall be provided for the fire pump room in accordance with NFPA 13, 20, and Section 21 1313.

C. Alarm and Supervisory Devices

1. Provide and install the following alarm and supervisory switches that shall be connected to the building fire alarm control panel (FACP) by the fire alarm contractor.
   a. Tamper Switches: All valves directly controlling water to the fire sprinkler system, and the valve controlling the fire pump test header, shall be provided with tamper supervisory devices. An off-normal signal shall be initiated during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position, whichever is less. Each tamper switch shall initiate a distinct supervisory indication. Underground key operated valves are exempt from this requirement.
   b. Fire Pump Monitoring: Monitor the following conditions from the fire pump controller:
      1) Engine running condition (supervisory)
      2) Controller main switch not in “Auto” (supervisory)
      3) Controller/ engine trouble (supervisory), including all conditions required by NFPA 20 Section 12.4.1.4 (as applicable)
   c. Means shall be provided to monitor the following conditions via the fire alarm system as separate, distinct points:
      1) Fuel leakage in annular space of fuel tank (supervisory)
      2) Low pump room temperature (supervisory)
   d. Waterflow Switches: The sprinkler riser in the pump room shall be provided with a vane-type waterflow device. Waterflow signals shall be priority signals that shall identify the flow device that is activated.
2. Alarm and supervisory switches shall be in accordance with Section 21 1313. Monitoring by the building fire alarm control panel shall be in accordance with Section 28 3100.

D. Provide and install all aboveground and underground piping required for a complete and usable fire pump installation in accordance with Section 21 1313, except as modified herein.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Submittal packages shall be submitted with the sprinkler system shop submittal package. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Drawings: Show detail plan view of the pump room including elevations and sections showing the fire pump, associated equipment, and piping. Plans, elevations, and sections shall be drawn to scale and shall indicate that the proposed arrangement of equipment will fit in the space provided. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point-to-point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Prepare an electronic set of working drawings (in PDF format) on sheets not smaller than 24 in. x 36 in. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.

B. Product Data: Submit an electronic set of descriptive data (in PDF format) annotated to show the specific model, type, and size of each item proposed. Full descriptive data, including, but not limited to, pressure/flow curves, selected options, wiring diagrams, schematics, etc. shall be submitted for all components essential to proper installation. Submit manufacturer's certified test characteristic curves for each pump, including pump discharge curves, with the corresponding shop test data points. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work. Include:
   1. Fire pump
   2. Driver
   3. Fire pump controller
   4. Pressure maintenance pump and controller
   5. Devices, materials and associated equipment
   6. Hose valve manifold test header

C. Installation, Operation, and Maintenance Data: Submit two (2) complete sets of the equipment manufacturer’s installation, operation and maintenance data for each fire pump, driver, controller, and other related equipment. Data shall be submitted bound together in a 3-ring notebook or other approved manner, with indexed tabs separating the data for each piece of equipment. Include, as applicable:
   1. Safety precautions
   2. Normal operations
   3. Emergency operations
   4. Environmental conditions
   5. Lubrication data
   6. Preventive maintenance plan and schedule
   7. Troubleshooting guides and diagnostic techniques
   8. Wiring diagrams and control diagrams
   9. Maintenance and repair procedures
   10. Removal and replacement instructions
   11. Spare parts and supply list
   12. Parts identification
   13. Warranty information
   14. Testing equipment and special tool information
   15. Contractor information

D. Submittals to the Authorities Having Jurisdiction

   Submit shop drawings and product data directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities’ field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

E. Project Record Documents
   1. Sprinkler Contractor’s Superintendent shall prepare, on a daily basis, redlined shop drawings to record as-built conditions. Submit completed redlined drawings to the Engineer at project completion.
   2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on reproducible vellum.

1.9 QUALITY ASSURANCE

A. Qualifications
   1. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures

relating to installation of fire pumps. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.

2. Contractor shall be a firm specializing in performing work of this Section with a minimum of three years experience and must be regularly engaged in making such installations.
3. Contractor shall have successfully installed fire pump systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify each system has performed satisfactorily in the manner intended for a period of not less than 18 months.
4. Contractor shall provide workers normally employed in the field and as otherwise specified in NFPA 13 and local ordinances.
5. All material shall be new and in good condition, free of defects, scratches, corrosion and contamination. Used equipment shall not be allowed.

B. Equipment and components shall bear the markings indicating the equipment or component is UL listed and FM approved.

C. Regulatory Requirements

1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13, NFPA 20, and NFPA 24, as applicable; to other applicable NFPA standards; to all Local, State and Federal codes; and to all other requirements specified herein. The advisory provisions (Appendices/Annexes) of the NFPA publications referred to herein shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, product data, and hydraulic calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal’s office.
3. Deviations from the contract documents and the contractor's approved submittal documents will not be permitted without written consent from the Engineer.
4. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 13, 20, 24, Local, State, or Federal requirements, and the requirements of the Authorities Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment and valves in shipping containers, with labeling in place. Maintain in place, protected from the environment, until installation.

1.11 SEQUENCING

A. Fire pump acceptance testing must be completed prior to the flushing of all underground fire service mains on the site. Filling of sprinkler systems with water prior to complete flushing shall only be permitted by special permission of the Engineer after appropriate filling procedures have been submitted and approved.

1.12 GUARANTEE

A. The Contractor, in addition to other warranties or guarantees required by the contract documents, shall guarantee workmanship on all piping, devices, and related materials for a period of one (1) year from the date of the Engineer’s final acceptance of the work. All defects shall be promptly corrected at no cost to the Owner.

B. The Contractor is responsible for providing a system that has been coordinated with the contract documents and approved by all concerns referenced in this document, including, but not limited to, the Owner, local authorities, and the Owner's representatives.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment supplied under this specification shall be new and shall be UL listed and FM approved for fire protection service and installed and used as intended by the listing.

2.2 FIRE PUMP EQUIPMENT

A. Each installation shall include a hose valve header, hose valves with caps and chains, automatic air release valve, circulation relief valve, eccentric and concentric reducers (as applicable), suction and discharge gauges, and all other devices and appurtenances as required by NFPA 20.

B. Diesel Engine-Driven Fire Pump
   1. The fire pump shall be a diesel-engine driven horizontal split-case, centrifugal fire pump. Pump ratings shall be as indicated on the fire protection drawings. The pressure rating shall be determined by the contractor's sprinkler system hydraulic calculations.
   2. Maximum fire pump discharge pressure shall not exceed 175 psig under any conditions. The use of a main relief valve or pressure limiting drive control technology to control the discharge pressure of the fire pump shall not be permitted. The maximum fire pump discharge pressure shall be calculated using the maximum static pressure expected at the suction flange of the pump, based on the high-water level elevation of the suction tank. A main pressure relief valve shall be provided, if required, only for the purpose of relieving excessive system pressure that could result from an overspeed condition on the diesel fire pump driver.
   3. The fire pump shall start automatically whenever system pressure on the discharge side of the pump is reduced to a preset start point, and manually whenever the start button is depressed. The pump shall continue to run after a start signal is received and shall be configured to run until manually stopped.

2.3 FIRE PUMP DRIVER

A. Diesel Engine Driver
   1. Diesel engine driver shall be listed per UL 1247 and/or FM-approved for fire pump service and shall be of the make and power rating recommended by the pump manufacturer for the pump being provided. Engine power shall be adequate to drive the pump at all conditions of speed and load over the full range of the pump performance curve. Engine power shall be per SAE conditions, properly derated for temperature and altitude as required by NFPA 20.
      a. Engine shall be derated for an assumed combustion air temperature of 120°F.
   2. Diesel engine shall be of the compression ignition type with electric starting device taking current from two battery units mounted not less than 12 in. above the floor. The engine shall be equipped with an engine block heater, dual battery contactors capable of mechanical operation to energize the starting motor in the event of control circuit failure, and an emergency manual fuel solenoid valve. The engine shall be arranged for 12- or 24-volt operation. Contractor shall provide heavy-duty commercial lead acid batteries for dual operation, battery rack, battery cables, and electrolyte. The diesel engine driver shall meet all applicable local regulations.
   3. Fuel System External to Engine

a. Provide in accordance with NFPA 20 and NFPA 37. Provide vent piping with weatherproof vent cap discharging to the exterior. Provide flexible bronze or stainless steel piping connectors with single braid at each piping connection to diesel engine. Supply, return, vent, and fill piping shall be steel piping.
   1) Steel Pipe: ASTM A 53, Weight Class XS (Extra Strong), black steel, threaded end connections. Provide ASME B16.3 threaded fittings and ASME B16.39 threaded unions.

b. Tanks: Double-walled construction in accordance with UL 80 or UL 142 for aboveground steel tanks. Provide bottom drain connection to annular space for connection of leak detection sensor. Provide bottom drain valve and plug connected to internal fuel tank to allow purge of sump volume. Provide low fuel level sensor for monitoring by controller.
   1) Leak Detection Sensor: Model FLS-TS manufactured by Chicago Technical Sales, Inc., or approved equal

c. Valves: Provide valves suitable for fuel oil service. Valves shall have union end connections or threaded end connections.
   a) Gate, Globe, and Angle Valves: MSS SP-80, Class 125
   b) Check Valves: MSS SP-80, Class 125, swing check
   c) Ball Valves: Full port design, copper alloy body, two-position lever handles

4. Exhaust System External to Engine

a. Provide in accordance with NFPA 20 and NFPA 37. Provide exhaust mufflers to reduce noise levels less than 85 dBA. Exhaust shall discharge to the exterior.
   1) Steel Pipe: ASTM A 53, Weight Class XS (Extra Strong), black steel, welding end connections. Provide ASME B16.9 or ASME B16.11 welding fittings of the same material and weight as the piping.
   2) Flanges: ASME B16.5, Class 150. Provide flanges at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 0.0625 in. thick. Provide ASTM A 193/A 193M, Grade B7 bolts and ASTM A 194/A 194M, Grade 7 nuts.
   3) Piping Insulation: Products containing asbestos will not be permitted. Provide exhaust piping insulation system inside the pump room. Provide a finished stainless steel jacket over insulation.

2.4 FIRE PUMP CONTROLLER

A. Controller shall be the automatic type and UL listed and/or FM approved for fire pump service. Pump shall be arranged for automatic start and manual push-button stop. Means for allowing automatic stop of the fire pump motor under other than test conditions shall not be connected. Controller shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 in. above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a Bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps, and supervisory power light.

B. Diesel Engine Controller
   1. Controllers shall be approved for diesel engine-driven fire pump service.
   2. Controller shall be equipped with two battery chargers, two ammeters, and two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller operating voltage shall match the diesel engine driver.

3. Controller shall be equipped with the following supervisory alarm functions:
   a. Engine Trouble (individually monitored)
      1) Engine overspeed
      2) Low Oil Pressure
      3) High Water Temperature
      4) High Discharge Pressure
      5) Engine Failure to Start
      6) Battery
      7) Battery Charger/AC Power Failure
      8) ECM selector switch in alternate ECM position (for engines with ECM controls only)
      9) Fuel injection malfunction (for engines with ECM only)
   b. Main Switch Mis-set
   c. Pump Running
   d. Pump Room Trouble (individually monitored)
      1) Low fuel level. Signal at two-thirds tank capacity
      2) Low Pump Room Temperature

   Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set.
4. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, engine running (two sets), engine trouble and pump room trouble, and terminals for remote start.
5. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch.
6. The controller shall be equipped with a weekly program timer with the capability to automatically start and run the engine for a test period of at least 30 minutes once per week. If during this test period the engine develops critically low lubricating oil pressure or high engine jacket coolant temperature, the controller shall initiate a "trouble on engine or controller" alarm as required by NFPA 20 and stop the engine. While in this stopped condition, if any other starting input is received by the controller, the controller shall restart and run the engine as required by NFPA 20.
7. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.
8. Provide controller with digital pressure readout which displays water system pressure, and paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory.
9. Controller shall be equipped for Pressure Limited Drive control.

2.5 PRESSURE MAINTENANCE PUMP

A. A pressure maintenance (jockey) pump shall be provided with the driver, controls, and pump accessory items specified by the pump manufacturer. The pump shall be electric-driven, centrifugal type with a rated capacity of 10 to 20 gpm. Provide approved, indicating, and supervised isolation valves in the jockey pump suction and discharge piping. Provide pressure gauge and approved check valve in the jockey pump discharge outlet.

B. The pressure rating shall be selected to allow the system pressure to be maintained at a minimum pressure at least 10 psi greater than the rated fire pump churn pressure plus the minimum available static pressure, but no more than 225 psi. A listed pressure relief valve shall be provided on the jockey pump discharge piping if the discharge pressure will exceed 175 psi; the wastewater from the relief valve shall be piped to the floor drain or exterior.

C. Pump shall draft directly from the suction tank and shall discharge into the system on the downstream side of the pump discharge control valve.

2.6 PRESSURE MAINTENANCE PUMP CONTROLLER

A. Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. The controller shall be equipped with monitoring for pump starts and elapsed run time, tell-tale light, and reset button (TornaTech Model JP3-Z139 or approved equal).

2.7 PRESSURE SENSING LINES

A. A completely separate pressure sensing line shall be provided for the fire pump and for the jockey pump. The sensing line shall be arranged in accordance with NFPA 20. The sensing line shall be ½-in. brass or copper tubing.

B. Each sensing line shall be equipped with two check valves. Each check valve shall have a 3/32-in. orifice drilled in its clapper. Check valves shall be mounted not less than 5 ft. apart on the sensing line. Ground-face union with orifice shall not be permitted.

C. A test connection shall be provided for each sensing line. Test connections shall consist of a brass ½-in. globe valve and ¼-in. gauge connection tee arranged per NFPA 20. The test connections shall be equipped with a 0 to 300 psi (cold water pressure) oil-filled gauge.

D. Each sensing line shall be connected to its respective pump discharge piping between the discharge piping control valve and the check valve.

2.8 PRESSURE RELIEF VALVES

A. ½- or ¾-in. relief valves shall be direct acting, spring loaded, diaphragm type specifically listed for fire protection system service.
   1. Pressure setting shall be adjustable by turning an adjustment screw to vary the spring loading on the diaphragm. The pressure adjustment setting shall be of a type that can be sealed/ locked to prevent tampering. The pressure range of the setting shall be from 20 to 200 psi, with the initial setting at 175 psig.
   2. Provide Cla-Val Model 55L or approved equivalent.

2.9 ABOVEGROUND PIPING SYSTEMS

A. Aboveground piping, valves, and appurtenances shall be per Section 21 1313, except as specified herein.

B. Fire Pump Test Header: Provide hose valve manifold with six, 2½-in. hose gate valves with caps and chains. Hose threads shall be American National Fire Hose Connection Screw Threads (NH) conforming to the requirements of NFPA 1963.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate the work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment, and shall take any necessary measures to keep the premises dry at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Prior to the operation (opening or closing) of any valve controlling water to the domestic or fire system, notification shall be given to, and approval obtained from, the General Contractor.

D. The A/E, Developer and Owner shall NOT be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. The responsibility rests with the Contractor.

E. Ream pipe and tube ends. Remove burrs and fins.

F. Prepare piping connections to equipment with flanges or unions.

G. All excess oil, dirt, pipe joint compound, rust, mill scale, and factory coatings shall be removed from piping and equipment. All dirt, debris and excess cutting oil shall be removed from the interior of all piping and equipment before it is erected.

3.2 INSTALLATION

A. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA Standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean. All wiring shall be in metal conduit.

B. Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 13 and NFPA 20, as well as the requirements of the local Authorities Having Jurisdiction. In addition, the fire pump, driver, and controller shall be installed in accordance with the written instructions of the manufacturer.

C. Contractor shall coordinate the layout of equipment, piping and materials to be located within the Pump Room with the General Contractor to assure sufficient space and openings to accommodate the entire installation, and accessibility for maintenance and replacements, if necessary.

D. Where required by manufacturer, properly torque bolts to manufacturer's specifications using a torque wrench.

E. The Contractor shall install the piping and equipment in accordance with approved shop drawings.

F. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

G. Provisions shall be made by the Contractor to protect fire pump equipment from exposure to elements or extreme climatic conditions, including freezing and high temperature, until accepted by the Owner.

H. Pump circulation relief valve discharge and packing gland weepage connections shall be routed separately to floor drain or exterior. Route pipe to avoid creating trip hazards. Floor drain shall discharge as required by the local sanitation authority.

I. Provide pipe stands and hangers in accordance with NFPA 13 and NFPA 20.

J. All wiring from the fire pump controller to the engine control panel shall be in rigid metal conduit, intermediate metal conduit, or liquid-tight flexible conduit. Where the conduit is run along a wall or the floor, the bottom of the conduit shall be located at least 12 in. above the pump room floor.

K. Sequence of operation
   1. Jockey pump stop point shall be set at ±175 psi.
   2. Jockey pump start point shall be 10-15 psi less than the jockey pump stop point.
   3. The fire pump start point shall be 5 psi less than the jockey pump start point.

4. The fire pump shall be arranged to run until manually shut off. Automatic shutoff capabilities shall not be installed or connected.

L. The fire pump test header shall be provided with a ball drip valve arranged to discharge to the exterior.

3.3 INSPECTIONS AND TESTING

A. The system shall be subject to inspection and acceptance by the Engineer and the Authorities Having Jurisdiction for the purpose of determining the system is in accordance with federal, state, local and specification requirements, applicable standards of the NFPA, and other related codes and standards.

B. The Contractor shall be responsible for performing and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification.

C. Inspection test procedures shall be submitted to the Engineer for approval prior to use.

D. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified a minimum of two weeks in advance of the tests in order to arrange attendance at the tests.

E. All connections related to the fire pump system, including, but not limited to, electrical and piping connections, shall be completely and permanently installed prior to the final fire pump acceptance test.

F. Final Acceptance Test
1. The contractor shall provide portable radios, hoses, nozzles, calibrated pitot gauges, calibrated pressure gauges, digital tachometer, volt/ammeter and any other equipment and personnel required to conduct a complete fire pump acceptance test. Certificates of gauge calibration no more than 6 months old shall be presented to the Engineer and the Authorities Having Jurisdiction prior to commencement of the acceptance test. The certificates shall be NIST traceable and provide the necessary corrections to the indicated gauge pressure at not less than 4 pressure points for each gauge.
2. Factory Authorized Representatives from the fire pump manufacturer, diesel engine driver manufacturer, and fire pump controller manufacturer shall be present for the complete operational testing of the fire pump and driver. The fire pump controller and diesel engine manufacturer's representative shall be an experienced technician employed by the manufacturer and capable of demonstrating operation of all features of the components including trouble alarms and operating features.
3. Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the Contractor to the Engineer prior to the time of the pump acceptance test.
4. Flow Tests
   a. Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity, and at full capacity of the pump installation.
   b. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Pump speed (rpm), suction pressure and discharge pressure readings shall be taken as part of each flow test.
   c. The securing of all hoses and nozzles during the tests is the responsibility of the contractor. Water flow testing shall be conducted in a safe manner with no destruction to the existing facility or new construction. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test at no additional charge to the Owner.
5. Starting Tests

a. Pumps shall be tested for automatic starting.
b. Setting of the pressure switches shall be tested when pumps are operated by pressure drop.
c. Tests may be performed by operating the test connection on the pressure sensing lines.
d. As a minimum, the pump shall be started automatically 6 times and manually 6 times, in accordance with NFPA 20.
e. The fire pump shall be in operation for at least 60 minutes during the acceptance testing.

6. Alarms: All pump alarms, both local and remote, shall be tested.
7. Miscellaneous
   a. Proper operation of pressure relief valves shall be verified following the testing of the fire pump.
   b. Valve tamper switches shall be tested.
   c. Pressure recorder operation, relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.
8. Correction of Deficiencies: If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.
9. Acceptance Test Documentation: Upon completion of required testing, submit complete pump acceptance test data. The pump acceptance test data shall be on forms that give detailed pump information such as that which is indicated in the Appendix of NFPA 20. All test data records shall be submitted with the Project Record Documents.

G. At the conclusion of the acceptance testing, the Contractor shall top off the diesel fuel tank in the pump room so that it is turned over to the Owner filled with fuel.

H. The Contractor shall perform supplemental tests and shall render additional services in connection with the fire pump equipment, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

~END OF SECTION~

SECTION 22 0000

PLUMBING GENERAL

GENERAL

1.1 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 0000 - HVAC General.

1.2 STANDARDS

A. All Plumbing systems shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides.
   1. The International Plumbing Code, 2006 Edition, with most current State of Georgia Amendments
   2. The International Building Code, 2006 Edition, with most current State of Georgia Amendments
   3. The International Gas Code, 2006 Edition, with most current State of Georgia Amendments
   4. International Energy Conservation Code, 2009 Edition, with most current State of Georgia Amendments
   5. Americans with Disabilities Act (ADA)
   6. ANSI/NSF 61 compliance is required for all components of the domestic water system.
   7. American Society of Plumbing Engineers (ASPE) Data Books
   8. National Fire Protection Association (NFPA) Standards:
      a. NFPA 30 - Flammable and Combustible Liquids Code
      b. NFPA 31 - Oil Burning Equipment
      c. NFPA 54 - National Fuel Gas Code
   9. Plumbing Drainage Institute (PDI)
   10. Underwriters Laboratories Inc. (UL)
   11. National Sanitation Foundation (NSF)
   12. Local and State Fire Marshal requirements
   13. Local Building and Inspection Department requirements
   14. Local Health Department requirements

B. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents.

Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.3 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.4 WORK INCLUDED

A. Systems
   1. The Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
      a. Domestic cold, hot and hot water recirculation systems
      b. Sanitary, drainage, waste and vent systems
      c. Natural gas/propane gas system
      d. Primary and emergency storm drainage systems

1.5 DRAWINGS

A. The Drawings are diagrammatic and do not necessarily depict exact conditions. The indicated locations of equipment, ductwork, piping, etc. are approximate only. The Drawings are schematic in nature and are not to be scaled. Scales are shown for reference and approximation only. Refer to the architectural drawings for dimensional data of building components.

B. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.6 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Plumbing equipment. Manuals shall include copies of control schematics, sequences of operations, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists and instructions manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

B. The Contractor shall give detailed instructions for a period of not less than two (2) days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.

C. Prior to final acceptance by the Owner, the Contractor shall submit a complete as-built drawing submittal for the Engineer's review, three (3) sets of operating and maintenance manuals, spare parts lists, drawings, wiring diagrams, troubleshooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.

D. A complete set of reproducible as-built drawings shall be provided indicating the location of all piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.

E. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

F. Provide all loose keys for supply valves, wall hydrants and hose bibbs installed.

G. Provide a full repair kit set (total relief valve kit, first check and second check kits) for each reduced pressure backflow preventer installed.

1.7 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size mylar and CD format.

1.8 EQUIPMENT, MATERIAL BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in Specifications or on Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.

C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction, capacities and performance. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

D. The Contractor shall coordinate the installation of all plumbing equipment proposed for use in this project with all building trades (architectural, structural, mechanical and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.9 START-UP-SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including water heaters, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.10 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.
   1. Plumbing fixtures, faucets and trim
   2. Water heaters and storage tanks
   3. Domestic water pressure booster system
   4. Insulation
   5. Floor drains and drainage accessories
   6. Hydrants and hose bibbs
   7. Mixing valves
   8. Submersible pumps
   9. Hot water return pumps
   10. Backflow preventers
   11. Grease/oil interceptors
   12. Pipe and fittings
   13. Valves
   14. Pipe supports
   15. Piping accessories
   16. Pipe labels and valve tags

B. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.

C. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

D. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

E. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

F. Included with submittals of plumbing equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the plumbing and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the electrical contractor.

Plumbing Contractor:_____
Project Manager Name:_____
Project Manager Signature/Date:_____

Electrical Contractor:_____
Project Manager Name:_____
Project Manager Signature/Date:_____

1.11 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure, shall be removed and relocated as required at no additional cost to the Contract.

G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

1.12 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used for plumbing systems shall be as specified herein.

B. Motor controls, system controls, starters, disconnects, pilot lights, push buttons, etc. shall be furnished by the Contractor compatible with the apparatus that it operates. Electrical equipment shall be wired for the voltage, as shown on the Electrical Drawings.

C. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

D. Electric motors shall be high efficiency, open drip-proof type unless otherwise specified. Motors shall be standard NEMA continuous duty type and shall bear the UL Label. Motors shall be selected with a minimum of 15% safety factory greater than the fan brake/horsepower (e.g. 4.75BHP would require a nominal 7-1/2 HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall meet Table MG-1-12C of EPACT 1992.

E. Motors controlled by a variable frequency drive (VFD) shall be inverter duty rated and fully compatible with the VFD provided.

F. Starters for motors 1/3 HP and smaller shall be manual type, and for 1/2 HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

G. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein.

H. Motor controls shall be either “Hand-Off-Auto” switches or “On-Off” push buttons with one indicating light. “Hand-Off-Auto” switches shall be provided for automatically controlled apparatus.

I. Motor starters that are not an integral part of equipment shall be installed in conformance with Division 26 - Electrical Requirements.

J. All “loose” disconnects and starters shall be installed by Division 26.

K. Power wiring to disconnects, starters, and equipment shall be provided and installed by Division 26. All equipment requiring electrical power shall be provided with disconnect switches at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer’s recommendations and Electrical Drawings.

L. The Contractor shall provide all system controls, control and interlock wiring 120 volts and less in conduits in accordance with materials and installation requirements of Electrical Section. All starters shall be labeled on face of starter.

M. All starters for 3-phase equipment shall have overload devices in all three (3) phases.

N. Wiring diagrams shall be furnished by the Contractor.

O. Acceptable manufacturers shall be General Electric, Square D, Eaton, Siemens and Allen Bradley.

2.3 PIPING SYSTEMS

A. General
   1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on the Drawings.
   2. Piping, valves and equipment used in similar applications shall be provided from the same manufacturer unless noted otherwise.

B. Domestic Cold Water System, Underground, 3 Inches and Larger, Suitable for Working Pressure of 125 psig to 5'-0" Outside Building
   1. Piping Systems
      a. Basis of Design
         1) Ductile iron thickness Class 51 for 3 inch and 4 inch size thickness, Class 50 for 6 inches and larger, ANSI A21.51, ASTM A746 with bituminous coating outside and cement mortar lining inside. Ductile iron mechanical or push-on joints and fittings ANSI/AWWA C110/A21.10.
      b. Deductive Alternates
         1) Mains where pressure is no greater than 100 psi: Polyvinyl Chloride (PVC), 160 psi water piping, ASTM D2241, SDR26 with mechanical or push-on joints with neoprene “O” rings, ASTM D3139.
         2) Mains where pressure is greater than 100 psi: Polyvinyl chloride (PVC), 200 psi water piping, AWWA C900, 200 psi, with mechanical or push-on joints with neoprene “O” rings, ASTM D3139.
   2. All valves, fittings, and changes in direction or elevation shall have joints restrained in accordance with NFPA-24.
   3. Trenching Conditions: Class B1 bedding with 4" minimum thickness of clean granular fill. Recesses shall be provided at all pipe barrels to ensure no loads are transmitted at the joint connections.

C. Domestic Cold Water and Hot Water Systems Above Ground
   1. Piping Systems
      a. Basis of Design
         1) Type “L” hard drawn copper tubing per ASTM B-88 and Federal Specification WWT-799. Fittings: Solder or brazed joint copper fittings per B16.18 or 16.22. Grooved copper fittings with full flow radius elbows, ASTM B-75, ASTM B-584, Victaulic CTS system, or Engineer approved equal. Copper pressed fittings with radius elbows, crimped connections and EPDM O-rings, ASTM B-88, 200 psi rating, Grinnell Fig. 640, Ridgid Viega ProPress, ProPress XL or Elkhart Xpress systems. Ductile iron mechanical couplings with bolted connection for grooved piping, ASTM A-536, with EPDM copper tube size gaskets, rated working pressure 300 psi. Joints: Soldered or brazed joints with lead-free brazing filler materials and compatible alloys.

D. Sanitary, Waste and Vent and Storm Drain Systems, Below Ground to 5'-0" Outside Building
   1. Piping Systems
      a. Basis of Design
         1) Schedule 40 DWV PVC pipe, ASTM 1785. Install per ASTM D 2321. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM 2665. Joints: Solvent joints for PVC, ASTM D-2564. (PVC piping is not acceptable for waste piping receiving discharge higher than 130 degrees F, cast iron piping is to be installed at the central plant, mechanical rooms and at all laundry and kitchen equipment discharges.)
      b. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.
      c. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.
      d. Foam core PVC piping is not acceptable for any drainage system.

E. Sanitary, Waste and Vent Systems and Storm Drainage Systems Above Ground
   1. Piping Systems
      a. Basis of Design
         1) Polyvinyl Chloride (PVC), schedule 40 DWV PVC pipe, ASTM 1785. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM 2665. Joints: Solvent joints for PVC, ASTM D-2564. PVC piping is not acceptable in plenum ceilings.
      b. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.

c. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.
d. Foam core PVC piping is not acceptable for any drainage system.
e. All cast iron pipe and fittings shall carry an NSF International listing.

F. Pumped Discharge Piping
1. Piping Systems
a. Schedule 40 seamless or welded galvanized steel pipe, ASTM A-53. Fittings: Class 125 and 250, cast iron threaded fittings, ASTM A-126, ANSI B16.4. Ductile iron rigid grooved couplings, EPDM gasket, 316 stainless steel nuts and bolts. Victaulic Style 77 (1,000 psi).
b. Type “L” hard drawn copper tubing per ASTM B-88 and Federal Specification WWT-799. Fittings: Solder or brazed joint copper fittings per B16.18 or 16.22.

2.4 VALVES, FLANGES AND UNIONS

A. General
1. All systems under this section shall be provided with valves to permit complete and sectional control of the system. They shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified. Valves shall be as manufactured by one of the following companies: American, Anvil International, FNW, Kennedy, Kitz, Milwaukee, Nibco, Powell, Stockham, Victaulic, Watts, or approved equal, and shall conform to description listed below.
2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings. The tower riser control valves will be provided with an access panel concealed below the lowest guestroom vanity or above the ceiling in the closet in the lowest level unless specifically noted otherwise.

B. Valve Description
1. Gate Valves
a. 2-1/2" and larger, Stockham G-634, 175 lb. flanged OS&Y.
b. 2" and smaller, Milwaukee Fig. UP149, 125 lb., sweat connection. 2-1/2" and larger, Milwaukee Fig. F-2885, 125 lb., flanged or Milwaukee CW 223 Butterfly valve with 10 pos. lever handle.
c. 8" and larger, Milwaukee CW 323 Butterfly valve with gear operator.
d. 2-1/2" and smaller, Milwaukee No. BB-SC100, threaded.
2. Check Valves
a. 2" and smaller, Milwaukee Fig. UP509, 200 lb., threaded.
b. 2-1/2" and larger, Milwaukee Fig. F-2974, 125 lb. flanged.
c. 2-1/2" and larger, Stockham G-939, 175 lb. flange.
3. Ball Valves
a. 2" and smaller, Milwaukee UPBA 100.
4. Plug Valves (Natural/Propane Gas System)
a. 1/2" and larger, Rockwell Nordstrom Fig. 142 or 143 lubricated plug valve, threaded or flanged as required, wrench operated.
b. 1/2" through 2", two-piece full port brass ball valve, FM and AGA approved, Watts series FBV-3 or equal.
5. Balancing Valves (Hot Water Recirculation)
a. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi minimum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.

b. Balancing valves shall be Flow Design Incorporated (FDI) model AC or MC or approved equal by ITT or Bell and Gossett.
c. Ball valves are not acceptable for balancing the hot water return system.

6. Backflow Preventers
   a. Backflow preventers shall be installed at all locations required by code and local authorities, at all connections to mechanical equipment, and elsewhere as shown on the Drawings. Backflow preventers shall be reduced pressure principle type and shall be a complete assembly including tight-closing shutoff valves before and after the device. The design shall include test cocks and a pressure-differential relief seating check valves. The device shall meet the requirements of and be certified by ASSE Standard 1013, AWWA Standard C-506, and USC Foundation for Cross-Connection Control. A strainer shall be located upstream of the device. Route relief outlet from cone receptor to an air gap fitting for discharge to sanitary sewer.
   b. Acceptable manufacturers are Ames Company, Apollo Valves, Hersey Products, Watts Regulator, and Zurn-Wilkins.
7. Class II turbine type water meters shall be installed downstream of the backflow preventer, on the domestic water supply to HVAC equipment make-up, irrigation supply, and pool/fountain supply to allow for a reduction in sewer rate charges.
8. Pressure Reducing Valves
   a. A duplex pressure reducing valve station shall be provided on all domestic water systems greater than 80 psi.
9. Flanges
   a. All flanges shall be faced and drilled for not less than 125 pounds steam working pressure complete with necessary adapter, and shall be of size and material of adjacent piping. All flanges shall be faced (raised or flat) to be compatible with connecting valves, equipment, etc. The connection of one raised face flange to a flat face flange shall not be permitted.
10. Unions and Joints
    a. Unions on drainage pipes on fixture side of traps may be slip or flanged joints with soft rubber washers or gaskets. Unions 2" and smaller on copper pipe shall be all brass with ground joint and shall be 250# copper to copper. Unions above 2" shall be flanged with gaskets. Provide union at water and gas connection to all equipment, except plumbing fixtures.

2.5 CLEANOUTS

A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
   1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers.

B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure 4530 or approved equal.

C. Base of stack cleanouts on hotel, condominium student housing, multi-family projects, etc. shall have the stack located behind the water closet at the lowest level to allow for concealing the base of stack cleanout behind the tank of the water closet.

D. Brass cleanouts shall be solid nut construction.

E. Provide Owner with three (3) wrenches for removing flush cleanout plugs.

2.6 FLOOR DRAINS

A. Setting Grades
   1. The plumbing contractor shall obtain exact elevation of finished grade at the top of the drains prior to setting any drains. Drains installed in excess of 1/4" below the adjacent finished floor shall be removed and reset to the correct elevation.

B. Drain Types
   1. All floor drain outlets shall be of size noted on the Drawings. All drains shall be equal to the assembly specified. Acceptable manufacturers are as follows: Josam Co., Zurn Co., J.R. Smith Co., Wade, or approved equal. Drains shall be acid-resisting where indicated.
   2. Floor drains noted as FD “G” for use in public spaces such as Restrooms, Locker Rooms, Showers, etc., shall be general purpose type. Drains shall be cast iron with 6" square nickel bronze strainer and trap primer connection. Drains shall be Jay R. Smith Figure 2005B-L-B6-P050 or approved equal.
   3. Floor drains noted as FD “M” for use in mechanical rooms shall be heavy duty type. Drains shall be cast iron shallow type, 12" diameter with ductile iron tractor grate, sediment bucket, and trap primer connection. Secured funnels shall be provided on all drains receiving condensate discharge to eliminate overflow or spillage. Drains shall be Jay R. Smith Figure 2141 series or approved equal. Drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
   4. Floor or hub drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
   5. Unless otherwise noted, acceptable manufacturers shall be Josam, Jay R. Smith, Mifab, Watts, and Zurn.

C. Trap Primers
   1. Drains not receiving a continuous discharge are to be provided with an automatic trap primer.
   2. Trap primers shall be in-line type actuated by flow independent of pressure, pressure activated primers are not acceptable. Josam models 88250 and 88300.

D. Roof Drains
   1. Roof drains labeled “RD” installed in poured concrete slab shall have a cast iron body with combined flashing and gravel stop, cast-iron dome. Jay R. Smith 1010 or approved equal.
   2. Roof drains labeled “RD” installed in steel construction or built-up roof shall have a cast iron body with combined flashing and gravel stop, underdeck clamp and sump receiver, adjustable extension and cast iron dome. Jay R. Smith 1015-R-C or approved equal.
   3. Emergency roof drains labeled “ERD” shall have a cast iron body, combined flashing and gravel stop, cast-iron dome, 3" minimum PVC standpipe under dome, under deck clamp, sump receiver and extension as required. Jay R. Smith 1070-C-R or approved equal.
   4. Roof drains labeled RD “S” for use at scupper drains shall be Jay R. Smith Figure 1520T-NB cast iron flush drain with nickel bronze strainer.
   5. Unless otherwise noted, acceptable manufacturers shall be Josam, Sioux Chief, J.R. Smith, Mifab, Watts, and Zurn.

2.7 ACCESS PANELS

A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.

B. Furnish access panels of proper size to service concealed valves, water hammer arrestors and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.

C. Panels shall have flush doors with No.14 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless

steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

D. Access panels are not allowed in gypsum ceilings in public spaces.

2.8 INSULATION

A. The following shall be insulated:
   1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
   2. All hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
   3. All horizontal storm drain piping and roof drain bodies.

B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with 4 lb. density sectional fiberglass insulation with a thermal conductivity not to exceed 0.24 with white all service jacket and vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “All Service Jacket” three-inch wide tape.

C. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab.

D. Materials as specified in this section shall be manufactured by CertainTeed, Johns Manville, Knauf, Owens Corning or equal. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			**Insulation Thickness for Pipe Sizes**				
Piping System Types	Fluid Temperature Range		1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	°F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--
Domestic Hot Water and Hot Water Recirculation	43-71	110-160	1.0	1.0	1.5	1.5	--
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	--
Horizontal Storm Drainage	Ambient	Ambient	--	--	1.0	1.0	1.0

2.9 PIPE SUPPORTS AND HANGERS

A. All piping shall be supported by means of hanger rods and pipe hangers from roof or floor structure using supplementary steel and/or lagbolts. Water supply pipe connecting to pumps, equipment, fixtures or fixture supplies shall be made rigid at the connection point.
   1. Piping shall be supported from new concrete construction with Anvil International Fig. 282 inserts or drilled expansion anchors.
   2. Piping shall be supported from new steel construction with Anvil International Fig. 131 beam clamp, Fig. 61 beam clamp, Fig. 66 welded beam attachment or Fig. 60 washer plate with all-thread rod.
   3. Piping and brackets shall be supported from hollow block construction using drilled masonry holes and cadmium plated toggle bolts.
   4. Piping shall be supported from wood truss construction with plated lag screws or bolts, B-3227 and B-3228.
   5. Pipe supports shall not be attached to floor or roof deck.
   6. Acceptable manufacturers are: Anvil, B-Line and FNW.

B. Unless otherwise noted, hangers and clamps shall be as listed below (all model numbers are B-Line Systems):
   1. Cast iron/steel pipe - B3100 or B3109.
   2. Insulated water pipe - B3100 or B3109 with B3151 placed over insulation protection saddle.
   3. Uninsulated bare copper pipe - B3170 CTC plastic coated.
   4. All supports and mounting hardware are to be galvanized, cadmium plated, or factory enamel painted.
   5. All supports on insulated piping systems shall be sized to fit outside the insulation and shall be provided with insulation inserts and shields at each hanger or support point.

C. Branch piping to fixtures in chases shall be supported with plastic or copper clamp type supports:
   1. B-Line Ruffin series.
   2. Holdrite Systems.

D. Maximum spacing between pipe hangers shall be:
   1. Steel pipe
      a. 1-1/4" and smaller: 6'-0"
      b. 1-1/2" – 2": 8'-0"
      c. 2-1/2" and larger: 10'-0"
   2. Cast iron soil pipe: 2" and larger: 10'-0"
   3. Copper tubing:
      a. 1/2" – 1-1/4": 5'-0"
      b. 1-1/2" – 2": 8'-0"
      c. 2-1/2" and larger: 10'-0"
   4. PVC/CPVC and all plastic pipe:
      a. 1-1/4" and smaller: 3'-0"
      b. 1-1/2" and larger: 4'-0"

E. At least one hanger shall occur within 2'-0" from where change in direction takes place. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support vertical risers. Vertical piping drops shall be rigidly anchored to structure at the top and bottom offsets and at eight foot increments along the vertical drop.

F. Special approved hangers that require less installation space are to be used where required due to ceiling space limitations.

G. All connections to pumps and other vibrating machinery shall be provided with stainless steel braided flexible hose connections. Connections to potable water systems shall meet ANSI/NSF 61 design standards.

2.10 WATER HEATERS – ELECTRIC

A. Provide electric storage type water heaters as specified on the Drawings.

B. Water heater shall carry a UL certification for 150 psi working pressure, an ASME temperature and pressure relief valve (T and P) sized for the heater, vacuum relief valve, immersion thermostat, glass lined tank, temperature gauge on outlet, and manual reset high limit control.

C. Provide a metal drain pan and 3" high concrete housekeeping pad at each water heater. Water heaters greater than 10 gallons shall be floor mounted.

D. Provide a combination ball/relief valve on the domestic water supply sized as indicated on the Drawings, Watts series BRV or approved equal.

E. The water heater shall carry a five-year minimum limited warranty for tank leakage.

F. Electric water heaters shall be as manufactured by:
   1. A.O. Smith
   2. Bradford White

3. Lochinvar
4. State

2.11 FLASHING

A. Vent pipes passing through roof shall be flashed watertight.

B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.12 FLOOR, WALL AND CEILING PLATES

A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.13 GALVANIC PROTECTION

A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings.

2.14 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
   1. Domestic hot, cold and hot water recirculation water piping
   2. Gas piping
   3. Primary and emergency storm drainage piping
   4. Sanitary, waste and vent piping

B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

C. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.

D. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag.

E. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.

F. Valve tags will include a “P” or “FP” lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems.

G. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

H. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.15 EQUIPMENT LABELING

A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.

B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
   1. Permanently attached plastic laminate signs with 1" high lettering.
   2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

EXECUTION

3.1 GENERAL REQUIREMENTS

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.2 EXCAVATION, TRENCHING AND BACKFILLING

A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.

B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12"

below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.

D. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.

E. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.3 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.

C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.4 CUTTING AND PATCHING

A. Work shall include all cutting, patching, masonry and carpentry required as part of the equipment installation when not provided by other sections of these specifications.

B. All work shall be performed as specified under architectural specification section for cutting and patching.

3.5 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for equipment where required.

B. Provide 3" thick housekeeping pads at floor mounted equipment a minimum of 3" larger than the entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.6 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, etc. shall be thoroughly cleaned both inside and out.

C. After testing and balancing of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

3.7 PAINTING

A. Painting, except as otherwise specified, will be done under another section of the specifications, but the Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The Contractor shall touch-up to match original finish any equipment scratched in shipment or installation. Touch-up painting of plumbing equipment shall be part of the plumbing work.

C. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces which are not galvanized (this includes piping systems). Rust preventative painting shall be part of the plumbing work.

D. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these specifications. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.8 EQUIPMENT SUPPORT

A. Major equipment supports (framed structural openings, etc.) shall be furnished and installed by others as shown on the Drawings. The plumbing work shall include, the furnishings and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all equipment.

B. Unless otherwise shown on the Drawings, all equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural joists shall be supported by the top chord only of such joists. Hangers shall not be attached to the bottom chord of any joists.

3.9 PIPE PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe penetrations. Sleeves for pipe shall be Schedule 40 black steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe.

B. The 1/4" minimum clearance shall be provided between the sleeve and the insulation on insulated piping systems. A gap of the insulation shall be omitted at each side of a rated wall penetration to allow for the required fire stopping.

C. As far as possible, all pipe penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

D. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

E. Pipe penetrations through exterior walls shall be sealed watertight with expandable link type seals by Thunderline, Linkseal or Engineer approved equal.

F. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, or approved equal.

3.10 FLASHING

A. All piping penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in other sections of these specifications.

B. Flashing for piping shall be sheet lead of not less than 6 pounds per square foot, shall have a base not less than 2 square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

3.11 PIPING SYSTEMS

A. Water Piping - General
   1. Pipe used in piping assembly must be clean of dirt and obstructions and shall have ends square and reamed before putting into the fittings.

2. All piping must be true and plumb with proper pitch for draining of the soldering.
3. All domestic water lines serving flush valve fixtures and washing machines shall be protected from water hammer by shock absorbers. Where shock absorbers are required they shall be as manufactured by Josam Mfg. Company, J. R. Smith, Sioux Chief Ind., Precision Plumbing or Zurn Mfg. Co. and shall conform to the Plumbing and Drainage Institute published requirements.
4. All connections to water heaters, tanks and equipment shall be made with unions or flanges. Insulated piping systems shall be installed to provide space for insulation.

B. Sanitary Waste, Vent, Indirect Waste and Storm Drain Piping - General
1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines four (4) inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.
2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the Drawings.
3. Main vent stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least three (3) feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward the waste line.
4. Threaded joints shall have American National taper screw thread with graphite and oil compound applied to the male threads.
5. Sanitary and vent stacks are to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.

C. Mounting heights, unless otherwise noted, are to the centerline of the equipment and/or device.

3.12 TESTING OF PIPING SYSTEMS

A. General
1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with a minimum 48-hour notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Sanitary Piping Systems
1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5

psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Interior Water Piping Systems
   1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.

D. Exterior Water Piping System
   1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.

E. Defective Work
   1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

F. Additional Tests
   1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
   2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
   3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.13 DISINFECTION OF WATER SYSTEM – INTERIOR AND EXTERIOR

A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.

B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hydrochloride solution and shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be flushed from the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.

C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

3.14 FIXTURE CONNECTIONS AND SUPPORTS

A. Wall fixtures shall be hung by means of carrier type fixture supports as manufactured by J.R. Smith, Josam, Mifab, Wade or Zurn.

3.15 SLEEVES

A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.16 INSTALLATION OF UNIONS

A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.17 TRAPS

A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.18 CLEANOUT INSTALLATION

A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

3.19 FLASHING INSTALLATION

A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.

B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

C. The Contractor is to inspect all existing plumbing system roof penetrations and repair/replace flashing as required to provide a watertight installation.

3.20 EQUIPMENT AND MATERIAL PROTECTION

A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.21 SPACE REQUIREMENTS

A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF PLUMBING GENERAL

SECTION 22 1600

NATURAL GAS PIPING SYSTEM

GENERAL

1.1 SYSTEM

A. Provide a complete system of natural gas piping from gas meter to all natural gas burning equipment and appliances.

B. All gas equipment specified herein shall be suitable for use with natural gas system.

1.2 DESIGN STANDARDS

A. The natural gas system shall be designed and installed in accordance with the requirements of the following codes and standards:
   1. The International Gas Code, 2006 Edition, with most current State of Georgia Amendments
   2. NFPA 54 - National Fuel Gas Code

PRODUCTS

2.1 PIPE AND FITTINGS

A. Underground Piping
   1. Schedule 40 black steel pipe, ASTM A53 with polyethylene jacket, welded joints and standard weight black steel butt weld or socket weld fittings, ASTM A243.
   2. Polyethylene pipe, ASTM 2513, with heat fusion joints and fittings, ASTM D2513.

B. Aboveground Piping
   1. Schedule 40 black steel pipe, ASTM A53 with welded joints and standard weight black steel butt weld fittings, ASTM A234 or socket weld fittings, ASTM A105.
   2. Schedule 40 black steel pipe, ASTM A53, with 150 pound steel slip-on welding flanges, ASTM A181, for connection to flanged valves and equipment.
   3. Schedule 40 black steel pipe, ASTM A53, with screwed joints and 150 pound threaded malleable iron fittings, ASME B.16.3.

2.2 JOINTS

A. Threaded joints shall be made with a pipe compound specifically listed as resistant to reaction with liquefied petroleum gas and shall be applied to male threads only. After cutting and prior to threading, pipe shall be reamed and shall have burrs removed.

B. Welded joints shall be fusion welded in accordance with the American Standards Code for pressure pipe, ASME B31.1, Section 6.

C. Flanged joints shall be faced true, provided with ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges of valves.

2.3 UNIONS

A. Unions in steel piping shall be 150 pound socket welded carbon steel conforming to ASME B.16.11 or class 150 malleable iron threaded fittings conforming to ASME B.16.3.

2.4 VALVES

A. Valves 3" in size and larger shall be semi-steel plug valves with cast iron body, lubricated cast iron plug, flanged ends, and wrench operated for 175 pound WOG. Valve shall be Rockwell Nordstrom Fig. 143 or equal.

B. Valves 2-1/2" in size and smaller shall have bronze body and plug, socket welded ends, and square head for 125 WOG. Valve shall be Crane or Fig. 250 or equal.

C. Full port ball valves 2" in size and smaller shall have brass body with chrome plated brass ball with threaded or socket welded ends, 600 psi WOG, FM approval, AGA approval. Valve shall be Watts series FBV-3 or equal.

D. Lubricated plug valves shall be lubricated at the factory and sealant shall be suitable for natural gas. Provide two valve wrenches for each type of valve specified.

E. Acceptable valve manufacturers are Rockwell Nordstrom, Crane, FNW, Stockham, Powell, Walworth, or Milwaukee.

2.5 PRESSURE REGULATING VALVES

A. Pressure regulator shall be cast iron, ductile iron or stainless steel, corrosion-resistant spring-loaded type with internal pressure relief, 175 psi working pressure. Provide threaded ends for piping 2" and smaller, flanged ends for piping 2-1/2" and larger. All regulator vents shall be extended to the exterior unless otherwise specified. Regulators equipped with and labeled for use with an approved vent-limiting device shall not require a vent to the exterior. Acceptable manufacturers are Fischer Regulators, Jordan Valve, Maxitrol, Rockwell and Sensus.

B. Low pressure regulators supplied from medium and high pressure gas systems shall be lock-up type high gas pressure regulators and shall be installed a minimum of ten feet upstream of the equipment inlet connection.

C. Where low pressure line regulators have inlet pressures exceeding 2 psi, a downstream over-pressure protection device (OPD) shall be installed in accordance with ANSI Z21.80.

D. Medium pressure regulators shall have a capped tee fitting (sediment trap) upstream from the regulator and a capped tee fitting installed not less than 10 pipe diameters downstream of the regulator.

2.6 PROTECTIVE COATING

A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using “Scotchwrap,” “CT Tapecoat” or “X-Tru-Tape.” Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.7 CATHODIC PROTECTION

A. All underground gas piping shall be cathodically protected. Provide a minimum of two 17-pound magnesium anodes containing 6% aluminum and 3% zinc alloy. Anodes shall be distributed equally along the pipe run, but spacing shall not exceed 100 feet between anodes. Each anode shall be attached to the pipe by the Caldwell or brazing process. The connecting wire shall be buried in backfill composed of 75% gypsum, 20% bentonite and 5% sodium sulphate. Wherever the underground gas piping rises above grade, provide an insulating dielectric fitting.

2.8 FIRE PLACE LOG LIGHTER

A. Cast iron burner bar, 10" long with 1/2" IPS threaded inlet, chrome plated three way loose key gas valve. Prier model number C-69 / C-64.

2.9 PIPE SUPPORTS & HANGERS

A. All piping shall be supported by means of hanger rods and pipe hangers from roof or floor construction using supplementary steel and/or lagbolts.
   1. Piping shall be supported from new concrete construction with Anvil International Fig. 282 inserts.
   2. Piping shall be supported from new steel construction with Anvil International Fig. 131 beam clamp, Fig. 61 beam clamp, Fig. 66 welded beam attachment or Fig. 60 washer plate with all-thread rod.
   3. Piping and brackets shall be supported from hollow block construction using masonry drilled holes and toggle bolts.
   4. Piping shall be supported from wood truss construction with plated lag screws or bolts, B-3227 and B-3228.

B. Unless otherwise noted, hangers and clamps shall be as listed below (all model numbers noted are B-Line Systems):
   1. Gas pipe – B3100 or B3109.
   2. All supports and mounting hardware are to be galvanized or cadmium plated.

C. Maximum spacing between pipe hangers shall be:
   1. 1/2": 6'-0"
   2. 3/4"-1": 8'-0"
   3. 1-1/4" and larger: 10'-0"

D. At least one hanger shall occur within two feet (2'-0") from where a change in direction takes place in the line. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support pipe. Equal manufacturers for hangers and clamps are B-Line Systems, Anvil International, Fee and Mason, PHD Manufacturing, or approved equal.

E. Piping on roofs shall be supported every six feet on piping 1/2" size, eight feet on piping 3/4" – 1" size, and ten feet on piping 1-1/4" and larger, and at each change in direction, with manufactured adjustable height stainless steel pipe stands with integral pipe roller guides or clevis hanger for securing horizontal piping. Pipe stands shall be secured to the roof per the roofing manufacturer's installation requirements. Pipe stands shall be Miro Industries Model 4-RAH Series or PPH Models PP10 or PS-1-2.

F. Pipe supports for rooftop gas piping may be painted fabricated steel pipe stands with integral pipe guides if approved by the roofing manufacturer.

EXECUTION

3.1 INSTALLATION

A. All interior gas systems shall be bonded to the building's grounding system per the requirements of NEC Section 250. A written statement bearing the names and signatures of the plumbing and electrical contractors indicating compliance with the NEC grounding requirements is to be submitted prior to project close-out.

B. A valved union shall be provided at each connection to a piece of equipment. Equipment provided with a flanged inlet shall have a flanged connection.

C. All valves installed in horizontal lines shall be installed with the stems horizontal or above.

D. All gas piping shall be graded at the maximum slope available to prevent traps. All horizontal lines shall slope to risers and from the risers to the meter or appliance.

E. Drip legs, 6" long, shall be provided in gas piping at ends of horizontal runs, at the base of risers, and at connections to equipment.

F. Provide pressure regulators at all required connections to equipment; regulators shall be provided at the pressure required by the equipment served. Extend all pressure regulator vents individually to the exterior per local code authority requirements.

G. Branch piping shall be taken off the top or sides of horizontal lines, but not from the bottom.

H. Changes in pipe size shall be made with reducing fittings. No bushings will be allowed.

I. No gas piping shall be placed underground inside the building.

J. All exterior ferrous metal gas piping, fittings and supports shall be primed and painted with two (2) coats of exterior grade enamel paint unless galvanized. The paint color shall be submitted to the Architect for approval.

K. All gas supply connections to food service equipment are to be provided with an AGA rated flexible connector with quick disconnect coupling. The flexible connector shall be 5'-0" minimum length or longer as required to allow for removal of the food service equipment item.

L. Underground Piping
   1. General:
      a. Lay, align, anchor and test pipe and make-up joints. Perform excavating, cleaning, laying, jointing and backfilling as concurrently as possible to maintain uniform installation. Replace or repair damaged materials to condition equal to new material.
   2. Excavation and Backfilling:
      a. Care shall be taken not to excavate below depth necessary.
      b. Do not leave unjointed piping in trench overnight. Backfill trenches by filling and tamping in not more than 6" layers after pipes, tanks, or other structures have been installed, tested and approved.
   3. Pipe Crossing:
      a. Lay lower pipe, backfill with crushed stone, gravel or concrete as directed and thoroughly compact to level of upper pipe.

3.2 TESTING

A. All piping is to be inspected and purged per the requirements of NFPA 54 and the local authorities' requirements.

B. The entire gas piping system shall be tested with compressed air to 100 psi for a period of two (2) hours.

C. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF NATURAL GAS PIPING SYSTEMS

SECTION 22 4000

PLUMBING FIXTURES

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 22 0000 - Plumbing General.

1.2 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install the plumbing fixtures, trim and supports, complete as indicated on the Drawings and as specified herein.

PRODUCTS

2.1 GENERAL

A. All fixtures shall be white, unless otherwise indicated.

B. All water closets shall have fully glazed trapways.

C. All exposed trim to be heavy polished chrome plated brass, unless otherwise indicated. Chrome plated escutcheons are to be provided on all exposed fixture and food service equipment supplies and waste lines.

D. Electric water coolers shall be ARI Certified and shall carry a UL Listing. Units shall use refrigerant which is approved for use without ozone depleting properties. All waterway components are to be certified as lead free.

E. All sinks and lavatories for use by the disabled shall have manufactured insulation shields on all supplies and P-traps per ADA requirements unless the vanities are provided with ADA compliant shrouds.

F. All exposed plumbing fixture items such as faucets and flush valves shall be provided with vandalproof trim.

2.2 CLEANOUTS

A. Cleanouts on exposed piping in unfinished areas shall be heavy duty cast iron with countersunk plug. Cleanouts shall be Jay R. Smith Figure 4220 or approved equal.

B. Cleanouts installed behind walls in finished areas shall be cast iron ferrule type for no-hub or service weight pipe with nickel bronze round frame and cover with securing screws. Cleanouts shall be Jay R. Smith Figure 4472T or approved equal.

C. Cleanouts installed in concrete floors shall be cast iron type with gasket seal ABS plug round adjustable ductile iron cover with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4231L-M or approved equal.

D. Cleanouts installed in tile floors shall be cast iron type with gasket seal ABS plug for easy removal, adjustable round nickel bronze top recessed for tile with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4151L or approved equal.

E. Cleanouts installed in carpeted areas shall be cast iron type with gasket seal ABS plug, nickel bronze round frame and cover with carpet marker. Cleanouts shall be Jay R. Smith 4031-Y or approved equal.

2.3 PLUMBING FIXTURES

A. The following is a list of acceptable manufacturers for the project:
   1. Fixtures: American Standard, Kohler, Toto and Zurn
   2. Faucets: American Standard, Chicago Faucets, Kohler, Moen, Speakman, Symmons and Zurn
   3. Stainless Steel Sinks: Elkay, Just, Kohler
   4. Trim: American Standard, Brasscraft, Kohler, McGuire and Zurn
   5. Drains, Carriers and Hydrants: Josam, Mifab, Prier, Jay R. Smith, Wade and Zurn
   6. Flush Valves: Sloan, Kohler, Zurn and American Standard

EXECUTION

3.1 INSTALLATION

A. All wall hung fixtures shall be supported on concealed chair carriers furnished complete with all necessary bolts, nuts, washers and gaskets unless noted otherwise. The adjustable nipple between the cast iron fitting and the closet bowl shall be threaded cast iron. Secure all floor pieces to floor slab.

B. All exposed piping in connection with fixtures shall be chromium plated. Where supply and waste lines pass through walls, provide chromium plated escutcheons and firmly secure in place.

C. Provide straight or angle supply valves on inlet supplies to all fixtures.

D. Fixtures, trim and methods of piping and installation shall conform to local plumbing code. All fixture types shall be the product of one manufacturer. All fixtures shall be white unless otherwise noted.

E. Bathtub waste and overflow fittings shall be provided with soldered metal connections or PVC solvent welded connections if required by code authorities to eliminate the requirement for access to the fitting.

F. Fixtures shall be cleaned, adjusted and left in proper working order before the project is turned over to the Owner. Flush and clean all faucet aerators prior to turn over. Adjust all faucet lever handles to be parallel to adjacent rear wall in the off position.

G. The Contractor shall furnish and install protective guards as required to protect fixtures against damage by normal operations of other trades. Bathtubs shall be provided with tub liners at all times during construction.

H. Caulk all floor and counter top mounted fixtures and behind all wall-hung plumbing fixtures with white, non-shrinking, silicone caulking eliminating all voids and cracks.

I. Coordinate the mounting height of all fixtures with the Architect prior to installation.

J. The Contractor shall obtain exact information relative to finish grade of the top of the floor drains. All floor drains shall be set flush with finished floors.

K. Cleanouts shall be provided where indicated on drawings and elsewhere as required by code.

L. Where test tees are installed at the base of the stack or on the stack, they may be used as a cleanout.

M. Provide the Owner with three (3) wrenches for removing flush cleanout plugs.

END OF PLUMBING FIXTURES

SECTION 23 0000

HVAC GENERAL

GENERAL

1.1 GENERAL REQUIREMENTS

A. Refer to Division 1 - General Requirements and any and all Supplementary or Special Requirements, all of which apply to work described in Division 23 - HVAC as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all HVAC systems. All HVAC work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher implied cost shall be included in the bid, and the Architect shall be notified of the discrepancy in writing.

1.2 CODES AND STANDARDS

A. All HVAC work shall conform to all ordinances and regulations of the City, County and State where the work will take place, including the requirements of all authorities having jurisdiction. The following codes, standards and references shall be observed as a minimum:
   1. The 2009 International Codes
   2. Georgia State Amendments to the Code
   3. National Fire Protection Association (NFPA) Standards and Guidelines
   4. Local and State Fire Marshal requirements
   5. Local Building and Inspection Department requirements
   6. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
   7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
   8. Underwriters Laboratories Inc. (UL)
   9. Americans with Disabilities Act (ADA)

B. If Code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.3 WORK INCLUDED

The HVAC Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to:

A. Airside Systems
   1. Equipment: including fans, unitary air conditioners, air handling units, fan-coil units, split systems, etc.
   2. Ductwork and Accessories: including sheet metal, duct-board, flexible ductwork, fire and smoke dampers, access doors, etc.
   3. Air Distribution Devices: including louvers, registers, grilles, diffusers, etc.

B. Refrigerant Systems
   1. Equipment: including condensing units, etc.
   2. Piping, Tubing and Accessories: including pipe, refrigerant tubing, valves, solenoids, thermal expansion valves, strainers, air vents, pipe and equipment drains, condensate drains, etc.

C. Equipment, Ductwork and Piping Supports
   1. Equipment Mounts: including roof curbs, concrete housekeeping pads, equipment rails, miscellaneous steel, etc.
   2. Hangers and Support Devices: including inserts, hanger rods, unistrut, cross-bracing, anchor bolts, pipe anchors, restraints, etc.
   3. Vibration Isolation and seismic restraint: including inertia bases, flexible couplings, expansion devices, snubbers, springs, waffle pads, seismic restraints, etc.

D. Insulation
   1. Ductwork Insulation: including exterior duct wrap, internal duct liner, fire wrap, etc.
   2. Piping and Equipment Insulation: including preformed, board and wrap.

E. Miscellaneous HVAC Equipment: Unit heaters, wall heaters, roof hoods, etc.

F. Automatic Temperature Controls
   1. Decentralized: including all thermostats, control dampers, control valves, programmable controllers, line and low-voltage wiring, smoke detectors, pressure sensors, gas sensors, control logic, etc.
   2. Building Automation System (BAS): same as above but networked to a central human-machine computer interface, including all software and programming, display graphics, etc.

G. Labor and Equipment: including project management, supervision, tradesmen, lifts, fork-trucks, cranes, scaffolding, saws, wrenches, etc.

H. Equipment and Valve Identification

I. Start-up and Commissioning

J. Demonstration and Owner Training

K. Testing, Adjusting and Balancing

1.4 ENGINEER'S DRAWINGS

A. The locations, arrangement and extent of equipment, devices, ductwork, piping, and other appurtenances related to the installation of the HVAC work shown on the Drawings are approximate and define the intent of the design. The Contractor shall not scale Engineer's Drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

B. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.5 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. cited on the Drawings and in the Specifications are for the purpose of describing type, capacity, function and quality of equipment and materials required. All project design and coordination between disciplines has been performed as if the named manufacturer and specific piece of equipment will be provided to the project by the Contractor.

B. Alternate equipment and/or materials other than that named on the Drawings and in the Specifications may be proposed for use, but all equipment and materials shall conform entirely to the specified base items. Proposed alternate equipment shall be substantially equal in size, weight, construction and capacity. Alternate equipment and materials shall be submitted only as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Requests for prior approval of alternate products shall be made at least ten (10) days prior to the bid date and as required by Division 1 - General Requirements. The Engineer shall consider the use of the alternate equipment based on the supportive documentation made available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall, in all cases, be final.

C. The Contractor shall coordinate the installation of all HVAC equipment proposed for use in this project with all building trades (architectural, structural, electrical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the equipment submittals for approval. When the Contractor requests substitution of alternate equipment, it is with the knowledge that he shall be responsible for any and all costs required by the substitution, including necessary engineering and construction revisions in his or any other contract or trade to satisfy the design intent shown on the Plans and described in the Specifications.

1.6 SUBMITTALS

A. The Contractor shall prepare, submit and obtain Engineer's review of all manufacturers' data on the HVAC equipment and systems prior to ordering, purchasing or installing any equipment or materials. Six (6) hard copies of the complete submittal are required, five of which will be reviewed and returned by the engineer. Electronic submittals (e.g. .pdfs, etc.) may be acceptable, if approved by the architect and described in Division 1 - General Requirements. All submittals shall be transmitted simultaneously in hard ring binders (or in a single .zip file), with the associated specification sections cited and the items submitted clearly identified. Partial submittals will be returned without review. Submittals, as a minimum, shall include:
   1. All HVAC items scheduled on the Drawings
   2. Equipment arrangement, ductwork and piping drawings. Contractor drawings shall be prepared at a minimum scale of 1/8" = 1'-0". A scale of 1/4" = 1'-0" scale is preferred. Drawings shall be indicative of actual equipment purchased and shall show all offsets, transitions, fittings, dampers, valves, hanger locations, etc. Sections are required in spatially tight areas (e.g. kitchens, laundries, central plants, mechanical rooms, etc.) The following will guide the Contractor as to minimum drawing detail required:
      a. Clearly indicate top and bottom of duct and pipe elevations. All elevations shall be coordinated as to not conflict with structural, plumbing, electrical and architectural trades.
      b. Indicate all offsets (both vertical and horizontal).
      c. Indicate graphically all duct and pipe joints and their lengths.
      d. Submit duct and pipe-work fabrication schedule indicating duct size range with minimum duct material gauges, pipe schedule being used, duct and pipe connection joint types, section lengths, duct reinforcement type and spacing, etc.
      e. Indicate graphically all ductwork to be fabricated with internal duct liner.
      f. Indicate all insulation for ductwork and piping.
      g. Indicate all dampers and valves as shown on design documents and called for in the specifications.
      h. Indicate all flexible connectors where required by specifications and notes.
   3. Flexible ductwork, duct-board, insulation and linings
   4. Dampers, louvers, air distribution devices
   5. Manufacturer's cut sheets of all piping and tubing materials
   6. Where split systems are used in a "long line application," submit manufacturer's refrigerant line set routing drawings and engineered calculations supporting the recommended suction and liquid line sizes. Identify and provide cut sheets of any and all accessories required to make the system complete, functional and reliable.

7. Valves, thermometers, pressure gauges
8. Roof curbs, equipment supports, hanger systems, vibration isolators, seismic restraints
9. Control equipment, systems and diagrams
10. Test and balance reports

B. All submittal approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of submittals by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines.

D. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

E. The Contractor shall provide a written statement confirming coordination of voltage requirements for all HVAC equipment requiring an electrical connection. Statement shall bear the names and signatures of the HVAC and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the Electrical Contractor.

HVAC Contractor: _____

Project Manager Name: _____

Project Manager Signature/Date: _____

Electrical Contractor: _____

Project Manager Name: _____

Project Manager Signature/Date: _____

1.7 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of the HVAC work and pay all charges incident thereto. He shall deliver copies of all certificates of permit and inspection to the Architect.

1.8 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Piping and other HVAC equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated ductwork, piping and other HVAC equipment installed should they interfere with the proper installation and mounting of electrical, plumbing equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all ductwork, piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other

materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The HVAC Contractor shall confirm that his work does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.9 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review. Manuals shall describe installation, operation and maintenance of all HVAC equipment and shall include copies of control schematics, sequences of operation, function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in (a) 3-ring binder(s).

1.10 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. The record shall be by red-line mark-up on the most current set of Engineer's Drawings kept in the field office. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Engineer's Drawings. As-built drawings shall accurately depict actual final arrangement of all HVAC items. As-built drawings shall be delivered to the Architect.

1.11 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. All reciprocating and scroll air conditioning compressors shall be provided with an extended 5-year parts warranty.

C. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PRODUCTS

2.1 GENERAL

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Engineer's Drawings shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection Label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.2 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used for HVAC systems shall be as specified herein.

B. Motor controls, system controls, starters, disconnects, pilot lights, push buttons, etc. shall be furnished by the HVAC Contractor compatible with the apparatus that it operates. Electrical equipment shall be wired for the voltage shown on the Electrical Engineer's Drawings.

C. Electric motors shall be high efficiency, open drip-proof type unless otherwise specified. Motors shall be standard NEMA continuous duty type and shall bear the UL Label. Motors shall be selected with a minimum of 15% safety factory greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7-1/2 HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall meet Table MG-1-12C of EPACT 1992.

D. Motors controlled by a variable frequency drive (VFD) shall be inverter duty rated and fully compatible with the VFD provided.

E. Starters for motors 1/3 HP and smaller shall be manual type, and for 1/2 HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

F. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein. Starters for motors 75 HP and greater shall be solid state, reduced voltage type.

G. Motor controls shall be either "Hand-Off-Auto" switches or "On-Off" push buttons with one indicating light. "Hand-Off-Auto" switches shall be provided for automatically controlled apparatus.

H. Motor starters that are not an integral part of HVAC equipment shall be installed in conformance with Division 26 - Electrical requirements.

I. All "loose" disconnects and starters shall be installed by Division 26.

J. Power wiring to disconnects, starters, and equipment shall be provided and installed by Division 26. All equipment requiring electrical power shall be provided with disconnect switches at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer's recommendations and electrical drawings.

K. The Contractor shall provide all system controls, control and interlock wiring 120 volts and less in conduits and in accordance with materials and installation requirements of Division 26 - Electrical.

L. All starters shall be labeled on the face of the starter with a semi-rigid plastic laminate nameplate with 1" high white letters on a black background securely affixed to the equipment. The label shall indicate equipment served by the starter (equipment tag used on the Drawings). Labels shall be furnished and installed by the Contractor.

M. All starters for 3-phase equipment shall have overload devices in each phase.

N. Wiring diagrams shall be furnished by the Contractor.

O. Acceptable manufacturers shall be General Electric, Square D, Eaton, Siemens and Allen Bradley.

EXECUTION

3.1 GENERAL

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such time and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Listed mounting heights are to the finished bottom of the device unless otherwise noted.

E. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.2 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, and test plugs until final connection to system is made.

C. All equipment, piping and ductwork shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer’s and supplier’s recommendations and in a manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.3 CUTTING AND PATCHING

A. The work shall include all cutting and patching required as part of the HVAC installation. Refer to Division 1 - General Requirements.

3.4 CONCRETE WORK

A. Construct curbs, pads and similar supports for equipment where required.

B. Provide 4" thick housekeeping pads for all floor mounted equipment, extending 6" beyond the area occupied by the equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Division 3 - Concrete. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

D. Mix and install grout for HVAC equipment base bearing surfaces and anchors. Provide forms as necessary and place grout to completely fill equipment bases.

3.5 EQUIPMENT SUPPORTS

A. Major equipment supports (structural steel frames, framed structural slab and wall openings, etc.) shall be furnished and installed by others; however, the HVAC work shall include furnishing and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all HVAC equipment.

B. Unless otherwise shown on the Drawings, all HVAC equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural bar joists shall be supported only by the top chord of the joists. Hangers shall not be attached to the bottom chord of any joists.

3.6 PIPE AND DUCTWORK PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be schedule 40 black steel. Sleeves for ductwork shall be 20-gauge galvanized steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be between the sleeve and the insulation.

B. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

C. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

D. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration. Pipe penetrations through exterior walls shall be sealed weather-tight with expandable link type seals by Thunderline, Linkseal, or Engineer approved equal.

E. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL-rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, or approved equal. Refer to Division 7 - Thermal and Moisture Protection.

3.7 FLASHING

A. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in Division 7 - Thermal and Moisture Protection.

3.8 EQUIPMENT LABELING

A. All HVAC equipment shall be labeled. This shall include all central plant, air handling or air conditioning equipment, air terminals, and other similar and miscellaneous equipment.

B. Labels for air terminals or other devices shall be located for optimum visibility through access panel or removed ceiling tiles.

C. Equipment labeling shall be one of the following, unless noted or specified otherwise:
   1. Permanently attached plastic laminated signs with 1" high lettering
   2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel

3.9 VALVE TAGS

A. Each valve in the HVAC system is to be provided with an individually numbered valve tag.

B. Valve tags are to be brass or plastic laminate, 1½" minimum diameter with brass chain and hook for securing to the valve.

C. Valve tags will include a designation to indicate the appropriate system. Numbering shall be consecutive for each service of the hot, chilled, steam, condensate return, or condenser water systems.

D. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

E. One (1) copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

3.10 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.

C. All water piping shall be chemically flushed and cleaned prior to circulating water through equipment.

D. After cleaning, filters shall be installed where required and all systems shall be tested and balanced.

E. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and left ready for use.

3.11 PAINTING

A. Painting will be done under Division 9 - Painting except as otherwise noted, but the HVAC Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The HVAC Contractor shall touch-up any equipment scratched in shipment or during installation to match original finish. Touch-up painting of HVAC equipment shall be part of the HVAC work.

C. Any visible ductwork through grilles, registers and diffusers shall be painted flat black.

D. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces not galvanized, including HVAC piping. Rust preventive painting shall be part of the HVAC work. Rust preventive paint shall be “Rust Destroyer” by Advanced Protective Products, Inc., Fairlawn, NJ, (201) 794-2000. Product shall have a 5-year warranty when applied directly over rust. Clean and prepare surface per manufacturer’s recommendations.

E. All painting and coating shall match the original finish and shall conform to the requirements detailed in Division 9 - Finishes.

F. Do not paint over equipment nameplates, nonferrous hardware, accessories or trim.

3.12 PRESSURE TESTING

A. Unless otherwise specified herein, all HVAC piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 100 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.

3.13 PERFORMANCE AND DEMONSTRATION TESTS

A. All testing and demonstration of any and all HVAC systems required for acceptance by any authorities having jurisdiction shall be included as part of the HVAC work. This shall include the furnishing of any and all testing equipment, smoke generation devices, and any other required equipment or accessories, and all necessary labor required to perform any required tests or demonstrations. The Contractor shall coordinate and verify all devices, equipment and sequence of testing and/or events with such authorities having jurisdiction. The Contractor shall perform a minimum of two (2) satisfactory preliminary tests or demonstrations prior to any formal tests and/or demonstrations for any code authorities, and shall give a minimum of five (5) days advance notice to the Engineer of any and all preliminary tests and/or demonstrations, indicating the date and time of such tests.

3.14 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner's key operating personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all HVAC equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all HVAC equipment and systems.

END OF HVAC GENERAL

SECTION 23 0300

ROOF CURBS

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.2 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work included under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install curbs complete as indicated on the Drawings and as specified herein.

PRODUCTS

2.1 GENERAL

A. Prefabricated curbs for HVAC equipment located on the roof shall be manufactured by Custom Curb, Inc., Pate, Thycurb, Roof Products and Systems, Inc., or approved equal.

2.2 ROOF CURBS

A. Curbs shall be Series CRC-3 fabricated to match any roof slope and have a minimum height of 16". Coordinate with the roof system used so that a minimum of 8" of the curb is above the finished roof for flashing purposes. The top of the curb shall be level and the slope of the roof shall be compensated for by the curb.

B. Curbs shall be a minimum of 18-gauge galvanized steel construction (or as deemed necessary by the curb manufacturer to support unit load) with fully mitered and welded corners and self-flashing without cant. The curb shall not sag more than 1" in 240" + or - when supporting the unit at the corners of curb only. The curb shall be internally reinforced with angle iron, factory insulated with 1-1/2", 3 lb. density fiberglass insulation, and shall be complete with factory installed pressure treated wood nailers. Coordinate sizes to match frames provided by others.

EXECUTION

3.1 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer’s printed instructions and as detailed on the Drawings. Curb manufacturer shall coordinate with HVAC and General Contractor.

END OF ROOF CURBS

SECTION 23 0593

TESTING, ADJUSTING AND BALANCING (TAB)

GENERAL

1.1 DESCRIPTION

A. Refer to specification section 23 0000 - HVAC General, all of which applies to work described in this section as if written in full herein.

B. The work described by this section of the specifications consists of furnishing all materials, instruments, labor, and appurtenances to test, adjust and balance all of the HVAC systems furnished and installed under Division 23 of the specifications.

C. The TAB agency shall be a subcontractor of the General Contractor and shall not report to or be paid by the HVAC Contractor. The HVAC subcontractor shall be responsible to cooperate with and provide for the balancing subcontractor any and all materials, services, labor, etc. to facilitate completion of the balancing work.

1.2 QUALITY ASSURANCE

A. The TAB agency and its specialist shall be certified members of Associated Air Balance Council (AABC) or certified by the National Environmental Balance Bureau (NEBB) to perform TAB service for HVAC, and vibration and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. The TAB agency shall have been in business for at least the past five years and must be free of disciplinary action by either the AABC or the NEBB during that time.

B. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity of this project and must be certified so by the TAB agency in writing.

C. The basic instrumentation shall be calibrated to accuracy requirements by its manufacturer, AABC or NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems. Provide calibration history of the instruments to be used for test and balance purpose.

D. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by the ASHRAE Handbooks and requirements stated herein shall be the basis for planning, procedures, tolerances and reports. Final report shall cite the exact names of publications used as a basis or reference for the TAB work or reports.

PRODUCTS

2.1 MATERIALS

A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

B. Provide for repair of insulation removed or damaged for TAB work to match installation.

EXECUTION

3.1 TAB PROCEDURES

A. TAB shall be performed in accordance with the requirements of the Standard under which the TAB agency is certified, either AABC or NEBB.

B. During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Adjustment of the temperature controls shall be coordinated by the TAB work specialist in conjunction with the Automatic Temperature Control Company's Engineer. Both shall cooperate to simulate a complete cycle for every system in every mode of operation (automatic, economizer, fire emergency, etc.).

D. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

3.2 AIR SYSTEMS TAB

A. Systems shall be tested, adjusted and balanced so that air quantities and temperatures at outlets are as shown on the Contract Drawings and so that the distribution from supply outlets is uniform over the face of each outlet.

B. Direct reading velocity meters may be used for comparative adjustment of individual outlets, but air quantities in ducts having velocities of 1,000 feet per minute or greater shall be measured by means of pitot tubes and inclined gauge manometers. Instrument test opening enclosures shall be provided as required at the direction of the TAB agency.

C. Adjustments shall be made in such a manner that splitter and volume adjusters close to air outlets will have the least pressure drop consistent with volume requirements. Primary balancing shall be obtained by adjustment of the dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities. Additional dampers or other air volume adjusters required to accomplish the balancing and adjusting shall be furnished and installed as part of the HVAC work.

D. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.

E. Check and readjust factory set minimum and maximum air terminal unit flow rates if necessary. Balance air distribution on full cooling maximum. Reset room thermostats and check operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when in the maximum heating mode.

F. Adjust fan speeds to provide design air flow. Adjust V-belt drives, including fixed pitch pulley requirements.

G. After completion of the testing, adjusting and balancing of the air systems, six (6) copies of a recognized complete set of reports showing the minimum following information shall be submitted to the Engineer for review:
   1. Systems inspection narrative on equipment and installation for conformance with design
   2. Duct Air Leakage Test Report
   3. Systems Readiness Report
   4. TAB report covering flow balance and adjustments, performance tests, vibration tests and sound tests. Required information:
      a. Location of each air outlet or inlet. This shall be presented in the form of a reduced size floor plan showing outlet number keyed to the outlet number in the report.
      b. Dimensions or size of each outlet or inlet

c. Type and manufacturer of diffusers, grilles, registers. Indicate duty as supply, return, exhaust, etc.
d. Cfm of air as indicated on the Drawings for each outlet or inlet with corresponding velocity
e. Velocity of air as measured and corresponding cfm at which system has been balanced and adjusted, for each outlet or inlet
f. Velocity of air measured and corresponding cfm, after each complete system has been balanced and adjusted, for each main branch or zone duct at the supply fan, the return fan and the exhaust fan, as the case may be
g. After each complete system has been balanced and adjusted, the total cfm at fan discharge, the total return air to the apparatus, the total outside air to the apparatus, the total outside air to the apparatus, static pressure at fan outlet, total static pressure for apparatus, fan speed, motor amperage for each phase and voltage

5. Narrative of uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements

H. The above testing, adjusting and balancing shall be performed for the first season of the year, cooling season or heating season, which occurs at the completion of the building. Additional balancing and adjusting which may be required for the season of the year next following shall be performed as part of the work under this specification.

3.3 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements for all rotating HVAC equipment of 1/2 horsepower and larger, including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to General Contractor. Where vibration readings exceed the allowable tolerance, the HVAC Contractor shall correct the problem and the TAB agency shall verify the corrections are done for final reporting.

3.4 SOUND TESTING

A. Perform and record required sound level measurements in approximately 15% of all rooms as designated by the General Contractor.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Where measure sound levels exceed specified levels, the installing contractor or equipment manufacturer shall take remedial action approved by the General Contractor and the necessary sound tests shall be repeated.

3.5 MARKING OF SETTINGS AND TEST PORTS

A. Following the approval of the final TAB Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the General Contractor.

B. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF TESTING, ADJUSTING AND BALANCING

SECTION 23 0700

HVAC INSULATION

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.2 WORK INCLUDED

A. The work done under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install all insulation, complete, as indicated on the Drawings and as specified herein.

PRODUCTS

2.1 MATERIALS

A. Materials as specified in this section shall be manufactured by Armstrong, Johns-Manville, Knauf, Pittsburgh-Corning, Certainteed, Pabco, Dow Chemical, Owens Corning or approved equal.

B. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes					
Piping System Types	Fluid Temperature Range		Runouts 2 in. +	1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	°F	In.	In.	In.	In.	In.	In.
(Heating Systems Steam & Hot Water)								
High Pressure/Temp	152-238	306-450	2.0	3.0	4.0	4.0	4.0	4.5
Medium Pressure/Temp	122-151	251-305	2.0	2.5	3.0	4.0	4.0	4.0
Low Pressure/Temp	94-121	201-250	1.5	2.0	3.0	3.0	3.5	3.5
Low Temperature	49-93	120-200	1.0	1.0	2.0	2.0	2.0	2.5
Steam Condensate (for Feed Water)	Any	Any	1.0	1.0	1.5	2.0	2.0	2.5
(Cooling Systems)								
Chilled Water*, Geothermal Heat Pump Loop, Condensate	4.5-13	40-55	1.0	1.0	1.5	1.5	1.5	1.5
Refrigerant or Brine	Below 4.5	Below 40	1.0	1.0	1.5	1.5	1.5	1.5

+ Runouts to Individual Terminal Units (not exceeding 12 ft. in length)

* For chilled water piping located in attics and other unconditioned spaces (excluding return air plenums), increase the pipe insulation thickness by 1/2" for pipe sizes up through 8". Insulation for piping 10" and larger shall be 2-1/2" thick.

C. Unless noted otherwise, the abovementioned piping systems inside the building shall be insulated with a 5 lb/cu. ft. (nominal) density sectional fiberglass insulation with a thermal conductivity (k factor) not to exceed 0.24. The jacket shall be fire retardant with a suitable vapor barrier. All joints and seams shall be sealed vapor tight. All joints and seams shall be lapped in place to form a continuous vapor barrier covering. All seams shall then be covered with “All

Service Jacket" (ASJ) 3" wide tape. The tape shall match the jacket. The tape shall be squeegeed in place to provide complete adhesion of the tape to the jacket and to provide a continuous vapor barrier covering. Exterior water piping shall be heat traced.

D. Piping installed outdoors shall be insulated with cellular glass insulation, Pittsburgh-Corning "Foamglas" or approved equal. Insulation thickness required to prevent condensation shall be determined by the manufacturer for worse case ambient conditions.
   1. Install with all service jacket and in accordance with manufacturer's recommendations.
   2. Where heat tracing is specified, oversize insulation to allow space for heat tape.

E. Equipment shall be insulated in the same manner as specified for the associated piping. Suitable provisions shall be made for breaking flanges as may be required for maintenance. Hot water pumps do not get insulated unless specifically called for. The following equipment, but not limited to, requires insulation: expansion tanks, air separators, chemical treatment "shot type" feeders, storage tanks, etc.

F. Provide high density preformed pipe insulation inserts at all pipe hangers. Inserts shall be equal to Foamglas by Pittsburgh Corning or calcium silicate. Provide ribbed hanger saddles by Centerline, Buckaroos, Inc. or approved equal.

G. Ductwork
   1. All supply air and return ducts shall be insulated.
   2. Toilet and general exhaust ductwork exhausting air conditioned air and routed in attic spaces shall be insulated.
   3. Ductwork described in 1. and 2. above shall be insulated with 3" thick blanket, 3/4 lb/cu. ft. with reinforced foil faced vapor barrier (R-10.2 min.). Insulation shall be securely adhered to ductwork. All joints shall be sealed with 3" wide strips of the foil faced vapor barrier tape and applied to form a continuous vapor seal.

H. All outside air ducts shall be insulated with blanket type insulated as described above.

I. Provide insulating tape over all piping specialties to prevent condensation such as drain valves, drain plugs, combination temperature/pressure test plugs, etc.

J. All insulation must meet applicable codes for Flame Spread and Smoke developed ratings.

EXECUTION

3.1 INSTALLATION

A. Shop drawing submittals shall include a complete package of materials and methods intended for use as described in this section.

B. All work shall be in strict accordance with applicable codes, ordinances and the manufacturer's recommendations.

C. All work shall be performed in a professional workmanlike manner and standard trade practice. It shall be smooth in appearance and suitable for finish painting.

D. All exterior piping shall be installed with a corrugated aluminum jacket with bands 3'-0" on center.

E. Fiberglass pipe insulation shall be applied to clean (free of rust) dry pipe prior to leak testing. Chilled and condenser water systems shall not be operated until the insulation is completely installed with a vapor barrier in place.

END OF HVAC INSULATION

SECTION 23 0900

DIRECT DIGITAL CONTROL SYSTEM

GENERAL

1.1 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:

1.2 DESCRIPTION

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in 23 0900 Appendix A (Sequences of Operation) shall be BACnet objects.

1.3 APPROVED CONTROL SYSTEM MANUFACTURERS

A. The following are approved control system suppliers, manufacturers, and product lines: Trane Tracer, Carrier, Automated Logic Corporation, Alerton, Honeywell, Siemens.

B. The above list does not indicate order of preference. Inclusion on this list does not guarantee acceptance of products or installation. Control systems shall comply with the terms of this specification.
   1. The Contractor shall use only operator workstation software, controller software, custom application programming language, and controllers from the corresponding manufacturer and product line unless Owner approves use of multiple manufacturers.
   2. Other products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

1.4 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications
   1. Installer shall have an established working relationship with Control System Manufacturer.
   2. Installer shall have successfully completed Control System Manufacturer’s control system training. Upon request, Installer shall present record of completed training including course outlines.

1.5 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Mechanical Code (IMC)
3. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

1.6 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
   1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
   2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
   3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
   4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
   5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
   6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
   7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
   8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
   9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
   10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15º (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical	±1% of reading (see Note 3)

Measured Variable	Reported Accuracy
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

Note 1: Accuracy applies to 10%–100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

1.7 SUBMITTALS

A. Product Data and Shop Drawings: Meet general requirements of Shop Drawings, Product Data, and Samples. In addition, the contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11" x 17" prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:
   1. DDC System Hardware
      a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
      b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
         1) Direct digital controllers (controller panels)
         2) Transducers and transmitters
         3) Sensors (including accuracy data)
         4) Actuators
         5) Valves
         6) Relays and switches
         7) Control panels
         8) Power supplies
         9) Batteries
         10) Operator interface equipment
         11) Wiring
      c. Wiring diagrams and layouts for each control panel. Show termination numbers.

d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software
   a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
   b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
      1) Central Processing Unit (CPU) or web server
      2) Monitors
      3) Keyboards
      4) Power supplies
      5) Battery backups
      6) Interface equipment between CPU or server and control panels
      7) Operating System software
      8) Operator interface software
      9) Color graphic software
      10) Third-party software
   c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show interface wiring to control system.
   d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
   a. Riser diagrams showing control network layout, communication protocol, and wire types.
   b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
   c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
   d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
   e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
   f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
   g. A point list for each control system. List I/O points and software points specified in Section 23 0900 Appendix A. Indicate alarmed and trended points.
4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.
5. Description of process, report formats, and checklists to be used in Section 23 0900 Article 3.16 (Control System Demonstration and Acceptance).
6. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

B. Schedules
   1. Within one month of contract award, provide a schedule of the work indicating the following:
      a. Intended sequence of work items
      b. Start date of each work item

c. Duration of each work item
d. Planned delivery dates for ordered material and equipment and expected lead times
e. Milestones indicating possible restraints on work by other trades or situations

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents of the documents shall be submitted for approval prior to final completion and shall include:
1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 0900 Article 3.16 (Control System Demonstration and Acceptance).
3. Operation and Maintenance (O&M) Manual.
4. As-built versions of submittal product data.
5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
10. Graphic files, programs, and database on magnetic or optical media.
11. List of recommended spare parts with part numbers and suppliers.
12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
14. Licenses, guarantees, and warranty documents for equipment and systems.
15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

1.8 WARRANTY

A. Warrant work as follows:
1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.

Respond during normal business hours within 24 hours of Owner's warranty service request.

2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
   1. Graphics
   2. Record drawings
   3. Database
   4. Application programming code
   5. Documentation

1.10 DEFINITIONS

Term	Definition
BACnet Interoperability Building Blocks (BIBB)	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application controllers, and application specific controllers.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.

Term	Definition
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the network
Wiring	Raceway, fittings, wire, boxes and related items.

PRODUCTS

2.1 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

B. Install new wiring and network devices as required to provide a complete and workable control network.

C. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
   1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
   2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 0900 Appendix A. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

F. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.

G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 OPERATOR INTERFACE

A. The Operator Workstation or server shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L.

B. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.

C. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J.

D. Hardware. Each workstation or web server shall consist of the following:
   1. Computer. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified elsewhere in this document. The following hardware requirements also apply:
      a. The hard disk shall have sufficient memory to store:
         1) All required operator workstation software.
         2) A DDC database at least twice the size of the delivered system database.
         3) One year of trend data based on the points specified to be trended at their specified trend intervals.
      b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.
      c. Minimum hardware configuration shall include the following:
         1) Dual or Quad Core Processor
         2) 6 GB RAM
         3) 500 GB hard disk providing data at 3.0 Gb/sec
         4) 16x DVD-RW drive
         5) Serial, parallel, and network communication ports and cables as required for proper DDC system operation

E. System Software.
   1. Operating System. Web server or workstation shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the DDC System manufacturer's minimum requirements for their software. Typically acceptable systems include Microsoft Windows7,Microsoft Vista, Microsoft Windows XP Pro, Windows Server 2003 or 2008, Red Hat Enterprise Linux, or Ubuntu Desktop 10.04.
   2. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
      a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
      b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.
      c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.
      d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Adobe Flash).
   3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
   4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves,

piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

F. System Applications. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
   1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
   2. Manual Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
   3. System Configuration. The workstation software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection. Operators shall be able to configure the system.
   4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
   5. Security. Each operator shall be required to log on to the system with user name and password in order to view, edit, add, or delete data.
      a. Operator Access. The user name and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users.
      b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.
      c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
   6. System Diagnostics. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be annunciated to the operator.
   7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 0900 Appendix A (Sequences of Operation). Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
   8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms.
   9. Alarm Reactions. Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
   10. Alarm and Event log. Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms, and archive closed alarms to the workstation or web server hard disk.
   11. Trend Logs. The operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure

trends as specified in Section 23 0900 Appendix A (Sequences of Operation). Trends shall be BACnet trend objects.

12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object or property in the system. The status shall be available by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
        1) Alarm History.
        2) Trend Data. Operator shall be able to select trends to be logged.
        3) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

G. Workstation Application Editors. Each PC or browser workstation shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.
1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a method of selecting the desired schedule and schedule type. Exception schedules and holidays shall be shown clearly on the calendar. The start and stop times for each object shall be adjustable from this interface.
3. Custom Application Programming. Provide the tools to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
    a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
    b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
    c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
    d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
    e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

g. Variables. Operator shall be able to use variable values in program conditional statements and mathematical functions.

1) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

2) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

H. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.4 CONTROLLER SOFTWARE

A. Furnish the following applications for building and energy management. All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. System Security. See Paragraph 2.3.E.5 (Security) and Paragraph 2.3.E.14.c.iii (Operator Activity).

C. Scheduling. Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:

1. Weekly Schedule. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
3. Holiday Schedules. Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

E. Binary Alarms. Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

F. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.

G. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.

H. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

I. Demand Limiting.
   1. The demand-limiting program shall monitor building power consumption from a building power meter (provided by others) which generates pulse signals or a BACnet communications interface. An acceptable alternative is for the system to monitor a watt transducer or current transformer attached to the building feeder lines.
   2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified in Section 23 0900 Appendix A (Sequences of Operation). When demand drops below adjustable levels, system shall restore loads as specified.

J. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 0900 Appendix A (Sequences of Operation).

K. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 0900 Appendix A (Sequences of Operation).

L. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.

M. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

N. Energy Calculations.
   1. The system shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
   2. The system shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

O. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

P. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.

Q. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 0900 Appendix A (Sequence of Operations).

2.5 CONTROLLERS

A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 0900 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

B. BACnet.
   1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
5. BACnet Communication.
    a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
    b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
    c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
    d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
    e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
    f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication
1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 0900 Appendix A shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

H. Memory.
   1. Controller memory shall support operating system, database, and programming requirements.
   2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
   3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.

C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0–10 Vdc), current (4–20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0–10 Vdc or a 4–20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog

output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.7 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
   1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
      a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
      b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.
   1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
      a. Dielectric strength of 1000 V minimum
      b. Response time of 10 nanoseconds or less
      c. Transverse mode noise attenuation of 65 dB or greater
      d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz

2.8 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers, unless otherwise specified elsewhere, shall be as follow.
   1. Type. Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings.
      a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
      b. Other modulating dampers shall be opposed-blade.
      c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
   2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (⅛ in.) extruded aluminum with reinforced corner bracing.
   3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
   4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
   5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 $L/s \cdot m^2$(10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
   6. Sections. Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
   7. Modulating dampers shall provide a linear flow characteristic where possible.
   8. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.
   1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
   2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
   3. Signal and Range. Proportional actuators shall accept a 0–10 Vdc or a 0–20 mA control signal and shall have a 2–10 Vdc or 4–20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
   4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
   5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

C. Control Valves.
   1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
   2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
      a. Water Valves:
         1) Two-way: 150% of total system (pump) head.
         2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
      b. Steam Valves: 150% of operating (inlet) pressure.
   3. Water Valves.
      a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
      b. Sizing Criteria:
         1) Two-position service: Line size.
         2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
         3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
         4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
         5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
      c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
         1) Water zone valves—normally open preferred.
         2) Heating coils in air handlers—normally open.
         3) Chilled water control valves—normally closed.
         4) Other applications—as scheduled or as required by sequences of operation.
   4. Steam Valves.
      a. Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.
      b. Sizing Criteria:
         1) Two-position service: pressure drop 10% to 20% of inlet psig.
         2) Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig.

3) Modulating service: 101 to 350 kPa (16 to 50 psig); pressure drop 50% of inlet psig.
4) Modulating service: over 350 kPa (50 psig); pressure drop as scheduled on plans.

D. Binary Temperature Devices.
1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C–30°C (55°F–85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m^2(10 ft^2) of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%–80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%–95% RH and shall be suitable for ambient conditions of -40°C–75°C (-40°F–170°F).
4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

H. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

I. Override Timers.
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6 hour

calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.
   1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
   2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
   3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.
   1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
   2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.
   3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.
   1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4–20 mA output with zero and span adjustment.
   2. Adjustable full-scale unit ranges shall be 100–130 Vac, 200–250 Vac, 250–330 Vac, and 400–600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
   3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.
   1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
   2. Transformers shall be suitable for ambient temperatures of 4°C–55°C (40°F–130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.
   3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

N. Power Monitors.
   1. Selectable rate pulse output for kWh reading, 4–20 mA output for kW reading, N.O. alarm contact, and ability to operate with 5.0 amp current inputs or 0–0.33 volt inputs.
   2. 1.0% full-scale true RMS power accuracy, +0.5 Hz, voltage input range 120–600 V, and auto range select.
   3. Under voltage/phase monitor circuitry.
   4. NEMA 1 enclosure.
   5. Current transformers having a 0.5% FS accuracy, 600 VAC isolation voltage with 0–0.33 V output. If 0–5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.

O. Hydronic Flowmeters
   1. Insertion-Type Turbine Meter
      a. Dual counter-rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Single turbine for piping 2 inches and smaller. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
      b. Insertion type complete with ‘hot-tap’ isolation valves to enable sensor removal without water supply system shutdown.
      c. Sensing method shall be impedance sensing (non-magnetic and non-photoelectric)
      d. Volumetric accuracy
         1) ± 0.5% of reading at calibrated velocity
         2) ± 1% of reading from 3 to 30 ft/s (10:1 range)

3) ± 2% of reading from 0.4 to 20 ft/s (50:1 range)

e. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).

f. Maximum operating pressure of 400 psi and maximum operating temperature of 200°F continuous (220°F peak).

g. All wetted metal parts shall be constructed of 316 stainless steel.

h. Analog outputs shall consist of non-interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 Vdc, and current output of 4-20 mA.

2. Magnetic Flow-Tube Type Flowmeter

a. Sensor shall be a magnetic flowmeter, which utilizes Faraday's Law to measure volumetric fluid flow through a pipe. The flowmeter shall consist of two elements, the sensor and the electronics. The sensor shall generate a measuring signal proportional to the flow velocity in the pipe. The electronics shall convert this EMF into a standard current output.

b. Electronic replacement shall not affect meter accuracy (electronic units are not matched with specific sensors).

c. Four-wire, externally powered, magnetic type flow transmitter with adjustable span and zero, integrally mounted to flow tube. Output signal shall be a digital pulse proportional to the flow rate (to provide maximum accuracy and to handle abrupt changes in flow). Standard 4-20 mA or 0-10 Vdc outputs may be used provided accuracy is as specified.

d. Flow Tube:

1) ANSI class 150 psig steel

2) ANSI flanges

3) Protected with PTFE, PFA, or ETFE liner rated for 245°F minimum fluid temperature

e. Electrode and grounding material

1) 316L Stainless steel or Hastelloy C

2) Electrodes shall be fused to ceramic liner and not require o-rings.

f. Electrical Enclosure: NEMA 4, 7

g. Approvals:

1) UL or CSA

2) NSF Drinking Water approval for domestic water applications

h. Performance

1) Accuracy shall be ±0.5% of actual reading from 3 to 30 ft/s flow velocities, and 0.015 ft/s from 0.04 to 3 ft/s.

2) Stability: 0.1% of rate over six months.

3) Meter repeatability shall be ±0.1% of rate at velocities > 3 ft/s.

3. Magnetic Insertion-Type Flowmeter

a. Magnetic Faraday point velocity measuring device.

b. Insertion type complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown.

c. 4-20 mA transmitter proportional to flow or velocity.

d. Accuracy: larger of 1% of reading and 0.2 ft/s.

e. Flow range: 0.2 to 20 ft/s, bidirectional.

f. Each sensor shall be individually calibrated and tagged accordingly against the manufacturer's primary standards which must be accurate to within 0.1% of flow rate and traceable to the National Institute of Standards and Technology (NIST).

4. Vortex Shedding Flowmeter

a. Output: 4-20 mA, 0-10 Vdc, 0-5 Vdc.

b. Maximum Fluid Temperature: 800ºF (427 °C).

c. Wetted Parts: Stainless Steel.

d. Housing: NEMA 4X.

e. Turndown: 25:1 minimum.

f. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
g. Body: Wafer style or ANSI flanged to match piping specification.

5. Transit-Time Ultrasonic Flowmeter
   a. Clamp-On transit-time ultrasonic flowmeter
   b. Wide-Beam transducer technology
   c. 4-20 mA transmitter proportional to flow or velocity.
   d. Accuracy: 0.5% of reading in range 1 to 30 ft/s, 0.001 ft/s sensitivity.

P. Thermal Energy Meters
1. Matched RTD, solid state, or thermistor temperature sensors with a differential temperature accuracy of ±0.15°F.
2. Flow meter : See "Hydronic Flowmeters" section.
3. Unit accuracy of ±1% factory calibrated, traceable to NIST with certification.
4. NEMA 1 enclosure.
5. Panel mounted display.
6. UL listed.
7. Isolated 4–20 ma signals for energy rate and supply and return temperatures and flow.

Q. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

R. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4–20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.)Transducer shall have 4–20 mA output, suitable mounting provisions, and 5-valve manifold.

S. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

T. Pressure-Electric (PE) Switches.
1. Shall be metal or neoprene diaphragm actuated, operating pressure rated for 0–175 kPa (0–25 psig), with calibrated scale minimum setpoint range of 14–125 kPa (2–18 psig) minimum, UL listed.
2. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.
3. Switches shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
4. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

U. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.

V. Local Control Panels.
   1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
   2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
   3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.

2.9 WIRING AND RACEWAYS

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

2.10 FIBER OPTIC CABLE SYSTEM

A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

EXECUTION

3.1 EXAMINATION

A. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

B. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

3.2 PROTECTION

A. The contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.

B. The contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The contractor shall protect any material that is not immediately installed. The contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

A. Site
   1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a

satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Test and Balance.
   1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
   2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
   3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
   4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

C. Life Safety.
   1. Duct smoke detectors required for air handler shutdown are provided under Division 26.
   2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23.
   3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.

D. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
   1. All communication media and equipment shall be provided as specified in Section 23 0900 Article 2.2 (Communication).
   2. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in Section 23 0900 Appendix A.
   3. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
   4. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
   5. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.4 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install equipment in readily accessible locations as defined by Chapter 1 Article 100 Part A of the National Electrical Code (NEC).

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.5 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 0900 Article 1.8 (Codes and Standards).

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

C. Contractor shall have work inspection by local and/or state authorities having jurisdiction over the work.

3.6 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes, and Division 26 of this specification, Where the requirements of this section differ from Division 26, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for the intended application.

E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway at levels below 3 m (10ft).

F. Do not install Class 2 wiring in raceways containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

G. Do not install wiring in raceway containing tubing.

H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.

I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers.

M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

O. Size of raceway and size and type of wire type shall be the responsibility of the contractor in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

P. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

Q. Use color-coded conductors throughout with conductors of different colors.

R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

S. Conceal all raceways except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues).

T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

U. Adhere to this specification's Division 26 requirements where raceway crosses building expansion joints.

V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of vertical raceways.

W. The contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

Y. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.7 COMMUNICATION WIRING

A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling

C. Do not install communication wiring in raceways and enclosures containing Class 1 or other Class 2 wiring.

D. Maximum pulling, tension, and bend radius for the cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

E. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to manufacturer’s instructions.

G. All runs of communication wiring shall be unspliced length when that length is commercially available.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. All communication wiring shall be labeled to indicate origination and destination data.

J. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

K. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
   1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
   2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
   3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
   4. An MS/TP EIA-485 network shall have no T connections.

3.8 FIBER OPTIC CABLE

A. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.

3.9 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.

D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.

E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m2(1 ft2) of coil area.

G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.

H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

J. Differential Air Static Pressure.
   1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the height-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
   2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.

K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

L. Install humidity sensors for duct mounted humidifiers at least 3 m (10 ft) downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.10 FLOW SWITCH INSTALLATION

A. Use correct paddle for pipe diameter.

B. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

A. General. Mount and link control damper actuators according to manufacturer's instructions.
1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic
1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer’s recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

C. Pneumatic Actuators.
1. Size pneumatic damper actuator to operate the related control damper(s) with sufficient reserve power to provide smooth modulating action or two-position action. Actuator also shall be sized for proper speed of response at the velocity and pressure conditions to which the control damper is subject.
2. Pneumatic damper actuators shall produce sufficient torque to close off against the maximum system pressures encountered. Size the pneumatic damper actuator to close off against the fan shutoff pressure, as a minimum.
3. Where two or more pneumatic damper actuators are installed for interrelated operation in unison, such as dampers used for mixing, provide the dampers with a positive pilot positioner. The positive pilot positioner shall be directly mounted to the pneumatic damper actuator and have pressure gauges for supply input and output pressures.
4. The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating. Provide at least one actuator for each damper section. Each damper actuator shall not power more than 2 m2(20 ft2) of damper.

5. Use line shafting or shaft couplings (jackshafting) in lieu of blade-to-blade linkages or shaft coupling when driving axially aligned damper sections.

3.12 WARNING LABELS

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the control system.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

C A U T I O N
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

C A U T I O N
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.

B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show the instrument or item served.

D. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.

F. Identify room sensors related to terminal boxes or valves with nameplates.

G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

H. Identifiers shall match record documents.

3.14 CONTROLLERS

A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in 15900 Appendix A (Sequences of Operation).

3.15 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and trend logging.

B. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 0900 Appendix A (Sequences of Operation). If character

limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 0900 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

C. Software Programming.
   1. Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the contractor. Embed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
      a. Text-based:
         1) Must provide actions for all possible situations
         2) Must be modular and structured
         3) Must be commented
      b. Graphic-based:
         1) Must provide actions for all possible situations
         2) Must be documented
      c. Parameter-based:
         1) Must provide actions for all possible situations
         2) Must be documented.

D. Operator Interface.
   1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints. As a minimum, show on each equipment graphic the input and output points and relevant calculated points as indicated on the applicable Points List in Section 23 0900 Appendix A.
   2. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.16 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.
   1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
   2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
   3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
   4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
   5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
7. Alarms and Interlocks:
    a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
    b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
    c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.17 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration.
1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.
6. Demonstrate compliance with Part 1, "System Performance."
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Demonstrate complete operation of operator interface.
9. Additionally, the following items shall be demonstrated:
    a. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop’s response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
    b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
    c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
    d. Interface to the building fire alarm system.

e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance.
1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 CLEANING

A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.19 TRAINING

A. Provide training for a designated staff of Owner’s representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives.
1. Day-to-day Operators:
a. Proficiently operate the system
b. Understand control system architecture and configuration
c. Understand DDC system components
d. Understand system operation, including DDC system control and optimizing routines (algorithms)
e. Operate the workstation and peripherals
f. Log on and off the system
g. Access graphics, point reports, and logs
h. Adjust and change system set points, time schedules, and holiday schedules
i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
j. Understand system drawings and Operation and Maintenance manual
k. Understand the job layout and location of control components
l. Access data from DDC controllers and ASCs
m. Operate portable operator's terminals
2. Advanced Operators:
a. Make and change graphics on the workstation
b. Create, delete, and modify alarms, including annunciation and routing of these

c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
d. Create, delete, and modify reports
e. Add, remove, and modify system's physical points
f. Create, modify, and delete programming
g. Add panels when required
h. Add operator interface stations
i. Create, delete, and modify system displays, both graphical and others
j. Perform DDC system field checkout procedures
k. Perform DDC controller unit operation and maintenance procedures
l. Perform workstation and peripheral operation and maintenance procedures
m. Perform DDC system diagnostic procedures
n. Configure hardware including PC boards, switches, communication, and I/O points
o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
p. Adjust, calibrate, and replace system components

3. System Managers/Administrators:
a. Maintain software and prepare backups
b. Interface with job-specific, third-party operator software
c. Add new users and understand password security procedures

C. Organize the training into sessions or modules for the three levels of operators listed above. (Day-to-Day Operators, Advanced Operators, System Managers and Administrators). Students will receive one or more of the training packages, depending on knowledge level required.

D. Provide course outline and materials according to the "Submittals" article in Part 1 of this specification. Provide one copy of training material per student.

E. The instructor(s) shall be factory-trained and experienced in presenting this material.

F. Classroom training shall be done using a network of working controller’s representative of installed hardware.

3.20 SEQUENCES OF OPERATION

See Section 23 0900, Appendix A (Sequences of Operation, With Points Lists).

3.21 CONTROL VALVE INSTALLATION

A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.

B. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.

C. Valves shall be installed in accordance with the manufacturer's recommendations.

D. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.

E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.

F. Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with ¼ inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.22 CONTROL DAMPER INSTALLATION

A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.

B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.

C. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.

D. Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.

E. Install extended shaft or jackshaft according to manufacturer’s instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)

F. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

G. Provide a visible and accessible indication of damper position on the drive shaft end.

H. Support ductwork in area of damper when required to prevent sagging due to damper weight.

I. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.23 SMOKE DAMPER INSTALLATION

A. The contractor shall coordinate all smoke and smoke/fire damper installation, wiring, and checkout to ensure that these dampers function properly and that they respond to the proper fire alarm system general, zone, and/or detector trips. The contractor shall immediately report any discrepancies to the engineer no less than two weeks prior to inspection by the code authority having jurisdiction.

B. Provide complete submittal data to controls system subcontractor for coordination of duct smoke detector interface to HVAC systems.

3.24 DUCT SMOKE DETECTION

A. Submit data for coordination of duct smoke detector interface to HVAC systems as required in Part 1, "Submittals."

B. This Contractor shall provide a dry-contact alarm output in the same room as the HVAC equipment to be controlled.

3.25 CONTROLS COMMUNICATION PROTOCOL

A. General. The electronic controls packaged with this equipment shall communicate with the building direct digital control (DDC) system. The DDC system shall communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics. The information to be communicated between the DDC system and these controls shall be in the standard object format as defined in ANSI/ASHRAE Standard 135 (BACnet). Controllers shall communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of Standard 135.

B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.

C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.

D. The Controller shall have a physical connection for a laptop computer or a portable operator's tool.

E. Environment. The hardware shall be suitable for the anticipated ambient conditions.
   1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40°C to 60°C (40°F to 140°F).
   2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

F. 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.

G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.

H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.

I. Transformer. Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3.26 START-UP AND CHECKOUT PROCEDURES

A. Start up, check out, and test all hardware and software and verify communication between all components.
   1. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
   2. Verify that all analog and binary input/output points read properly.
   3. Verify alarms and interlocks.
   4. Verify operation of the integrated system.

APPENDIX A: Sequences of Operation

1. Packaged Rooftop Units - Warehouse Areas

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - A 78°F (adj.) cooling setpoint
  - A 65°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - An 85°F (adj.) cooling setpoint.
  - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Optimal Start:
The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Emergency Shutdown:
The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.

Supply Air Smoke Detection:
The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

Supply Fan:
The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Stages:
The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Gas Heating Stages:
The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

Economizer:
The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air enthalpy is less than 22% (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the outside air enthalpy is less than the return air enthalpy.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation - Fixed Percentage:
The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

Mixed Air Temperature:
The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Humidity:
The controller shall monitor the return air humidity and use as required for economizer control (if present) or humidity control (if present).

Alarms shall be provided as follows:

- High Return Air Humidity: If the return air humidity is greater than 70% (adj.).
- Low Return Air Humidity: If the return air humidity is less than 35% (adj.).

Return Air Temperature:
The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

2. Packaged Rooftop Units - Office Areas

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - A 75°F (adj.) cooling setpoint
  - A 70°F (adj.) heating setpoint.
- Unoccupied Mode (night setback): The unit shall maintain
  - An 80°F (adj.) cooling setpoint.
  - A 60°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).

- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:
The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:
The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:
A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Emergency Shutdown:
The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.

Supply Air Smoke Detection:
The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

Supply Fan:
The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan in Hand: Commanded off, but the status is on.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Cooling Stages:
The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The cooling shall be enabled whenever:

- Outside air temperature is greater than 60°F (adj.).
- AND the economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Gas Heating Stages:
The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.

The heating shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

Economizer:
The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

The economizer shall be enabled whenever:

- Outside air temperature is less than 65°F (adj.).
- AND the outside air enthalpy is less than 22% (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the outside air enthalpy is less than the return air enthalpy.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:
When in the occupied mode, the controller shall measure the return air CO2 levels and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 750 ppm (adj.).

Dehumidification:
The controller shall measure the return air humidity and override the cooling sequence to maintain return air humidity at or below 60% rh (adj.). Dehumidification shall be enabled whenever the supply fan status is on.

Mixed Air Temperature:
The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).

Alarms shall be provided as follows:

- High Mixed Air Temp: If the mixed air temperature is greater than 90°F (adj.).
- Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

Return Air Carbon Dioxide (CO2) Concentration Monitoring:
The controller shall measure the return air CO2 levels.

Alarms shall be provided as follows:

- High Return Air Carbon Dioxide Concentration: If the return air CO2 concentration is greater than 1000ppm (adj.) when in the occupied mode.

Return Air Humidity:
The controller shall monitor the return air humidity and use as required for economizer control (if present) or humidity control (if present).

Alarms shall be provided as follows:

- High Return Air Humidity: If the return air humidity is greater than 70% (adj.).
- Low Return Air Humidity: If the return air humidity is less than 35% (adj.).

Return Air Temperature:
The controller shall monitor the return air temperature and use as required for economizer control (if present).

Alarms shall be provided as follows:

- High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
- Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

3. Exhaust Fans - On/Off (EF-5,6,7,8)

Run Conditions - Scheduled:
The fan shall run according to a user definable schedule.

Fan:
The fan shall have a user definable (adj.) minimum runtime.

Fan Status:
The controller shall monitor the fan status.

Alarms shall be provided as follows:

- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.
- Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

APPENDIX B: Glossary of Terms

Terms used within the Specification Text:

- **Advanced Application Controller (AAC):**

A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

- **Application Specific Controller (ASC):**

A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

- **BACnet/IP:**

An approved BACnet network type which uses an Ethernet carrier and IP addressing.

- **BACnet MS/TP:**

An approved BACnet network type which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BACnet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

- **BACnet over ARCNET:**

An approved BACnet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BACnet controllers is an EIA485 twisted pair topology running at 156,000 bps.

- **Building Controller (BC):**

A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

- **Direct Digital Control (DDC):**

A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting setpoints on an analog pneumatic or electronic controller.

- **PICS - Protocol Implementation Conformance Statement:**

A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

- **Smart Actuator (SA):**

An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-20mA, relay, etc.)

- **Smart Sensor (SS):**

A sensor which provides information to the BAS via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

- **Web services:**

Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.

Terms used within the Sequences of Operation:

- **adj.**

Adjustable by the end user, through the supplied user interface.

AI, AO, etc. (Column Headings on Points List)

AI = Analog Input. A physical input to the control module.
AO = Analog Output. A physical output from the control module.
AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only AVs are typically used to display the status of a control operation.
BI = Binary Input. A physical input to the control module.
BO = Binary Output. A physical output from the control module.
BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only BVs are typically used to display the status of a control operation.
Loop = A control loop. Most commonly a PID control loop. Typically a control loop will include a setpoint, an input which is compared to the setpoint, and an output which controls some action based upon the difference between the input and the setpoint. A PID control loop will also include gains for the proportional, integral, and derivative response as well as an interval which controls how frequently the control loop updates its output. These gains may be adjustable by the end user for control loop "tuning," but in self-tuning control loops or loops which have been optimized for a specific application the gains may not be adjustable.
Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.
Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)
Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

Note: If the specifications require use of the BACnet protocol, all of the above shall be provided as BACnet objects.

- **KW Demand Limiting: ***

An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold.

When power consumption exceeds defined levels, the system automatically adjust setpoints, de-energizes low priority equipment, and takes other pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.

- **Occupant Override Switch, or Timed Local Override:**

A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.

When the override time expires, the zone returns to its unoccupied state.

- **Occupant Setpoint Adjustment:**

A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling setpoints of selected zones. Typically the user interface for this function is built into the zone sensor.

- **Optimal Start-Up: ***

A control strategy that automatically starts an HVAC system at the latest possible time yet ensures comfort conditions by the time the building becomes occupied.

In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied setpoint.

The optimal start algorithm often includes a self-learning feature to adjust for variations from design capacity.

A distributed system must use Run on Request with Optimal Start. (See below.)

- **Requested, or Run on Request: ***

A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

The source equipment runs when one or more receiving units request its services. An operator determines how many requests are required to start the source equipment.

For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up sequence. If this AHU depends on a central chiller, it can send a run request to the chiller.

The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

- **Trim and Respond, or Setpoint Optimization: ***

A control strategy that optimizes the setpoint of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its setpoint.

For example, if all zones are comfortable and do not request cooling, the AHU will gradually increase (trim) its supply air setpoint. When a zone requests cooling, the AHU responds by dropping its setpoint. The more zones that request cooling, the more it drops the setpoint. The AHU repeats this process throughout the day to keep zones cool, but with a supply air setpoint that is no cooler than necessary.

Contracting Terms:

- **Furnished or Provided:**

The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

- **Install or Installed:**

The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.

- **Interface:**

The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

- **Integrate:**

The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.

APPENDIX C: Abbreviations

The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

AC - Air Conditioning
ACU - Air Conditioning Unit
AHU - Air Handling Unit
AI - Analog Input
AO - Analog Output
AUTO - Automatic
AUX - Auxiliary
BI -Binary Input
BO -Binary Output
C -Common
CHW - Chilled Water
CHWP - Chilled Water Pump
CHWR - Chilled Water Return
CHWS - Chilled Water Supply
COND - Condenser
CW - Condenser Water
CWP - Condenser Water Pump
CWR - Condenser Water Return
CWS - Condenser Water Supply
DA - Discharge Air
EA - Exhaust Air
EF - Exhaust Fan
EVAP - Evaporators
FCU - Fan Coil Unit
HOA - Hand / Off / Auto
HP - Heat Pump
HRU - Heat Recovery Unit
HTEX - Heat Exchanger
HW - Hot Water
HWP - Hot Water Pump
HWR - Hot Water Return
HWS - Hot Water Supply
MAX - Maximum
MIN - Minimum
MISC - Miscellaneous
NC - Normally Closed
NO - Normally Open
OA - Outdoor Air
PIU - Powered Induction Unit
RA - Return Air
RF - Return Fan
RH - Relative Humidity
RTU - Roof-top Unit
SA - Supply Air
SF - Supply Fan
SP - Static Pressure
TEMP - Temperature
UH - Unit Heater
UV - Unit Ventilator
VAV - Variable Air Volume
VVTU - Variable Volume Terminal Unit

W/ - with
W/O - without
WSHP - Water Source Heat Pump

END OF DIRECT DIGITAL CONTROL SYSTEM

SECTION 23 2300

REFRIGERANT PIPING

GENERAL

1.1 DESCRIPTION

A. Furnish and install all materials, labor, accessories, etc. shown on the Drawings and specified herein to completely install all piping systems.

B. Refrigerant piping shall meet the requirements of the American National Standard Safety Code for Mechanical Refrigeration (ANSI/ASHRAE 15-78, B9.1), and the Code for Pressure Piping (ANSI B31.5).

PRODUCTS

2.1 REFRIGERANT PIPING

A. Piping shall be minimum type “L” or refrigeration service copper tubing and shall conform to ANSI H23.5 standard for seamless copper tubes for refrigeration field service.

B. Fittings shall be wrought copper.

C. Joints shall be brazed.

D. Valves, filter-driers and other accessories shall be suitable for refrigerant service.

2.2 INSULATION

A. Refrigerant suction piping shall be insulated with 3/4" thick flexible elastomeric tubing insulation, AP Armaflex Pipe Insulation manufactured by Armacel or equal. Where possible, insulation shall be slid over piping from one end before pipe ends are joined and shall not be slit or cut. All joints and seams shall be sealed weather-tight.

B. Finish coat for flexible elastomeric insulation installed outdoors shall be water-based latex enamel designed for use over all forms of flexible elastomeric insulation. Finish coat shall provide a protective finish suitable to both indoor and outdoor applications, formulated for cold weather flexibility to resist cracking and weather-resistant to ultraviolet (UV) and ozone. Coating shall be Armaflex WB Finish or equivalent.

EXECUTION

3.1 GENERAL

A. Refrigerant piping shall be supported as shown on the Drawings and as required at intervals not over 8'-0" O.C. and at all turns and offsets. Hangers shall be copper plated tubing hangers of adequate size to fit around tubing and insulation as required. Saddles shall be used under insulated tubing to protect insulation.

B. Refrigerant piping shall be clean and free of outside contaminants at all times. Prior to start-up of any equipment or insulation installation, all piping shall be cleaned, tested, dehydrated and charged as recommended by the refrigerant compressor manufacturer.
   1. Procedure: Joints and connections in refrigerant piping shall not be installed in partitions or walls or where inaccessible for testing, inspection and rework. Make provisions to

prevent contact of dissimilar metals. During construction, cap all tubing to prevent moisture from entering. Keep in dry location.

2. Leak testing and recharging: Upon completion of installation of air conditioning equipment, test all refrigerant piping, components and accessories, including quick-connect refrigerant connectors for evaporator and condensing unit; test with a halide torch; prove tight by Contractor to assure a leak-tight refrigerant system. If leaks are detected at the time of installation or during warranty period, remove entire refrigerant charge from system, correct leaks, and retest system. After system is found to be leak free, evacuation shall be accomplished by use of a reliable gauge and a vacuum pump capable of pulling vacuum of at least one mm Hg absolute. Accomplish system evacuation in strict accordance with equipment manufacturer's printed instruction. System leak testing, evacuation, dehydration and charging with refrigerant shall comply with requirements contained in ARI Standard 260.

C. All joints in refrigerant piping shall be made accessible. Joints shall not be permitted below concrete.

D. All piping shall be run true to grade and shall be arranged to make the best possible appearance. Except where otherwise required by conditions of installation, all piping shall be symmetrical and parallel with lines of buildings or structure in which it is installed. All piping shall be run concealed except in mechanical room and where indicated otherwise.

E. All piping and equipment shall be supported and guided. Anchors shall be provided to absorb or transmit thrust and eliminate vibration or pulsation. Hangers or supports shall be provided near each change of direction. Supports shall be so located or shall be of such type as not to unduly restrict the movement of the pipe due to lateral or longitudinal expansion.

END OF REFRIGERANT PIPING

SECTION 23 3100

DUCTWORK AND ACCESSORIES

GENERAL

1.1 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 0000 - HVAC General.

B. Furnish and install all material, labor, accessories, etc. shown on the drawings and as specified herein to completely install all ductwork systems.

C. Ductwork systems shall be classified as follows:
   1. Static pressure class +2" W.G. - from constant volume air handling unit to supply diffusers, and all return and exhaust ductwork

D. Ductwork shall be constructed according to the latest edition of SMACNA ductwork construction standards applicable to the system pressures described above, and the system material construction.

E. Duct sizes shown on the drawings are nominal inside clear.

PRODUCTS

2.1 DUCTWORK

A. All ductwork shall be constructed of galvanized steel sheets of the thickness listed in the SMACNA manuals for the pressures referenced above.

2.2 FIRE DAMPERS

A. Type B or C fire dampers with the blade stack out of the airstream shall be installed at all locations where ductwork penetrates any floor, wall or partition with a fire rating of 1 hour or more and where otherwise shown on the drawings. Fire dampers shall have a rating compatible with the floor, wall or partition, and shall be UL 555 rated. Type A fire dampers with the blade stack in the airstream may be used behind grilles or where space conditions do not permit the use of a Type B damper.

B. All fire dampers shall be of the “Dynamic” type as classified in UL Standard 555.

C. Slab, Wall and Partition Dampers
   1. Dampers shall be factory built curtain type. They shall conform to the requirements of NFPA Standard 90 and be UL labeled for the required rating (1-1/2 hour minimum).
   2. Provide factory built sleeves of design and length to permit mounting within the opening.
   3. All dampers shall be installed in strict accordance with the manufacturer’s UL approved installation.
   4. Where fire dampers are shown on the drawings, and if fiberglass ductwork is used, dampers shall be installed in sheet metal duct extending on both sides of the partition as required by governing code authorities.

2.3 FLEX DUCT CONNECTORS

A. Install flex duct connectors at connections of sheet metal duct to motor driven equipment, or otherwise noted. Flex duct connectors shall be glass fabric coated with neoprene, suitable for service. Install per manufacturer’s instructions, and support sheet metal ductwork so that no weight is supported by flex duct connector.

B. Flex duct connectors shall also be provided at building expansion joints.

2.4 ACCESS DOORS

A. Hinged, gasketed and latched access doors and/or panels shall be installed at each fire and smoke damper, each duct mounted smoke detector, each valve, at each duct mounted balancing damper or any other mechanical equipment or device that requires accessibility. Doors and panels shall be sized and located to optimize access to dampers, detectors, and other equipment for service and replacement. Access doors in ductwork shall be per SMACNA Standards. Access doors and panels in walls, ceilings or other surfaces shall be coordinated with architectural finishes, and shall be as manufactured by Cesco Products.

2.5 FLEXIBLE DUCTWORK

A. Flexible ductwork shall be UL Class I air duct.

B. Flexible ductwork (maximum 8'-0") shall be installed between main supply ducts and diffusers.

C. Take-offs shall be made using spin-in type fittings with scoop and balancing damper. Flexible ductwork shall be Thermaflex M-KE R-6 (R value = 6.0 minimum or as required by local energy code) flexible air duct or approved equal. Duct size shall be the same size as diffuser neck it serves.

D. Flexible duct connections to ceiling diffusers shall be installed without kinks or sags to provide unrestricted airflow. Provide Flex Flow Elbow supports by Thermaflex.

2.6 AUTOMATIC CONTROL DAMPERS

A. Automatic control dampers shall be installed as shown on the drawings and shall be controlled as described in the 23 0900 - Direct Digital Control System section of these specifications.

B. Dampers shall be of the opposed blade type constructed of minimum 18-gauge galvanized steel and shall have rigidly constructed blades less than 6" wide, and shall have duct mounting flanges.

C. Dampers shall be of the low leakage type with replaceable blade and jamb seals. Damper leakage shall not exceed 6 cfm per sq. ft. of damper area at 4 in. w.c.

2.7 DUCT INSULATION

A. Also refer to Section 23 0700 - HVAC Insulation.

B. Supply air ductwork a minimum of 10 linear feet (or as indicated) downstream of low pressure air handling equipment shall be internally lined with 1" thick, 3 lb/cu. ft. acoustical duct liner, Certainteed “Toughgard 2” textile duct liner or approved equal.
   1. Duct liner shall be securely fastened to ductwork with stick pins, speed washers and adhesive. Leading edges of liner in medium pressure ductwork shall have a sheetmetal nosing.
   2. Exposed edges and butt joints shall be “buttered” with duct sealer.

C. Return air ductwork and transfer ducts shall have 1" thick, 1-1/2 lb/cu. ft. duct liner, Certainteed “Toughgard 2” textile duct liner or approved equal.

2.8 SMOKE DAMPERS

A. Smoke dampers with airfoil shaped blades shall be installed at all locations where ductwork or supply or return air openings penetrate any floor, wall or partition with a smoke rating, or where otherwise shown on the drawings, except where such ductwork or openings are part of an engineered smoke removal system. Smoke dampers shall have a rating compatible with the floor, wall, or partition, and shall be Class I, UL555S rated.

B. Smoke dampers shall be provided with actuators capable of closing the damper on activation of area smoke detectors or fire alarm system, and shall be normally closed. Wiring of actuators shall be by the mechanical contractor. Actuators shall be compatible with activating smoke detectors or fire alarm system (coordinate with other trades).

EXECUTION

3.1 DUCTWORK

A. All ductwork shall be installed in accordance with applicable SMACNA Standards according to the pressure class described in PART 1 - GENERAL.

B. Ductwork shall be supported as recommended by SMACNA Standards from structural members. Ductwork shall not be allowed to rest on ceilings, light fixtures or structural members. Ductwork supported from joists shall be supported from the top chord of all joists.

C. All ductwork accessories shall be installed in strict accordance with manufacturer's recommendations.

D. All ductwork shall be leak tested in accordance with SMACNA Standards. All ductwork seams shall be sealed with mastic to provide a system that is within the allowable SMACNA leakage limits. Six (6) copies of the ductwork test report shall be submitted to the Engineer prior to the Contractor's request for final payment.

E. All ductwork shall be cleaned inside and out prior to system start up, and shall be left in a neat and orderly manner.

F. Ducts, unless otherwise approved, shall be true to dimensions indicated, straight and smooth on inside with neatly finished joints; securely anchor to building in an approved manner, and install to be completely free from vibration under all conditions of operation. Exact routing of ductwork will be dependent on location of framing members. Route duct to avoid cutting framing members. Duct sizes shown on drawings are inside clear dimensions.

G. Brace ducts not more than 60 inches on center. Make slip joints in direction of flow. Unless otherwise indicated, elbows shall have a centerline radius of not less than 1 ½ times the width of the duct. Where space limitations necessitate use of short radius or square elbows, install turning vanes. Offset ducts around obstructions where possible. Where duct must encompass obstruction, area of duct shall remain constant. Duct tapers shall not exceed 1:4 ratio and transformations 30 degrees between air flow and diverging or converging air flow. Provide access doors for access to all equipment, dampers and motors concealed by sheet metal.

3.2 DAMPERS

A. Install dampers where indicated on drawings. Provide friction damper behind face of each supply outlet which shall be adjustable through the face of the grille with a screwdriver.

END OF DUCTWORK AND ACCESSORIES

SECTION 23 3400

UNITARY EXHAUST AND SUPPLY FANS AND VENTILATORS

GENERAL

1.1 DESCRIPTION

A. Refer to specification section 23 0000 - HVAC General, all of which applies to work described in this section as if written in full herein.

B. Furnish and install all unitary exhaust and supply fans and ventilators of the size, type, capacity and characteristics as shown on the equipment schedules and herein described.

C. Acceptable manufacturers include only those whose products have been in satisfactory use in similar service for not less than five (5) years.

D. Electrical Standards: Provide electrical motors and products which have been listed and labeled by Underwriters Laboratories Inc. and comply with NEMA Standards.

E. Certification, Fan Performance: Provide fans whose performance is certified by AMCA under the specified conditions.

PRODUCTS

2.1 CENTRIFUGAL AND AXIAL FANS AND VENTILATORS

A. All units shall be rigidly constructed of materials suitable for the intended service and shall be installed with all accessories listed on the Drawings.

B. All roof mounted units shall be installed on insulated roof curbs of the proper type, size and construction for proper mounting. Curbs shall account for all roof slopes and pitches so that the unit is installed level. Units shall be anchored to curbs by a minimum of two lag screws of adequate size on each side. Curbs shall be constructed of galvanized steel, except when the project is located within 5 miles of a sea coast they shall be of aluminum construction.

C. Outdoor fans shall be completely weatherproof for outdoor installation and shall contain internal vibration isolation to assure smooth and quiet performance.

D. Fan wheels and blades shall be constructed of aluminum and shall be statically and dynamically balanced at the factory.

2.2 CEILING-CENTRIFUGAL AND CABINET FANS

A. Units shall be direct-drive type with back-draft damper, acoustically insulated cabinets and speed controller.

EXECUTION

3.1 GENERAL

A. All units shall be installed in accordance with manufacturer's recommendations and as shown on the Drawings.

B. Ceiling-centrifugal and cabinet fans shall be supported from structural members and shall not rest on the ceiling, on lights or on structural members.

C. Units shall be interlocked and controlled as indicated on the Drawings.

D. Ceiling-mounted units shall be installed with ceiling grilles flush with the ceiling.

E. Curb-mounted fans shall be secured to the roof curb with lag screws in each hole in the fan curb cap.

F. Electrical connection to the fan motor shall be made through the roof opening inside the roof curb.

END OF UNITARY EXHAUST AND SUPPLY FANS AND VENTILATORS

SECTION 23 3700

LOUVERS, GRILLES, REGISTERS AND DIFFUSERS

GENERAL

1.1 DESCRIPTION

A. Furnish and install all louvers, grilles, registers and diffusers of the size, type, capacity, and characteristics as shown on the equipment schedules and described herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

PRODUCTS

2.1 LOUVERS

A. Louver components (heads, jambs, sills, blades, etc.) shall be factory assembled by the manufacturer into a complete unit. Louver sizes too large for shipping shall be built-up by the Contractor from factory assembled louver sections to provide the overall sizes required.

B. Louver design shall incorporate structural supports required to withstand a wind load of 20 lbs. per square foot.

C. All louver performance data submitted for approval shall bear the AMCA Certified Ratings Seal for Air Performance and Water Penetration.

D. All louvers shall have a standard factory applied finish coating with color selection made by the Architect at the time of shop drawing approval. Color charts shall be submitted with louver shop drawings.

2.2 GRILLES, REGISTERS AND DIFFUSERS

A. Units shall be of the type, size, and construction as scheduled on the Drawings.

B. Unless otherwise noted on the Drawings, all units shall be supplied with a factory finish of white baked enamel.

C. Grilles, registers and diffusers shall be ordered with borders compatible with the ceiling system type in which they are installed.

D. Aluminum devices shall be used for all areas subject to excessive moisture or humidity (e.g. showers, pools, bathrooms, etc.).

EXECUTION

3.1 LOUVERS

A. Louvers shall be installed according to manufacturer's recommendations, and shall be caulked and sealed at the frame and flanges to make the installation weatherproof.

B. Combination louver dampers shall be installed with required damper operators and linkage mechanisms and shall be field adjusted for full opening/closure stroke. Louvers shall be interlocked as indicated on the Drawings.

3.2 GRILLES, REGISTERS AND DIFFUSERS

A. All units located in ceiling tiles shall be centered or shall be on quarter points of 2 ft. x 2 ft. tiles.

B. Where a line of sight allows the ductwork, wall or ceiling structure to be seen behind any units, such ductwork, wall or ceiling structure shall be painted with nonflammable flat black paint to minimize visibility.

C. All units not installed on T-bar ceiling grids shall be securely fastened to adjacent structures.

D. Where air distribution devices are installed in inaccessible ceilings, provide spin-in with scoop without volume damper. Provide opposed blade damper in neck of air distribution device with access to damper control through face.

END OF LOUVERS, GRILLES, REGISTERS AND DIFFUSERS

SECTION 23 7400

SINGLE PACKAGE ROOFTOP AIR CONDITIONERS

GENERAL

1.1 DESCRIPTION

A. Furnish and install factory assembled, piped and wired single package rooftop air conditioners of the type, operational characteristics and capacity as shown and scheduled and as specified herein. All rooftop units shall be by the same manufacturer. The manufacturer shall have available factory trained service engineers and an inventory of replacement parts within a 100-mile radius of the job site.
   1. Acceptable manufacturers are Trane, Carrier, Lennox, and York.
   2. Compressor shall be warranted against parts failure for five (5) years.
   3. Submit catalog cuts, certified performance data, and dimensional data.

PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Unit shall be designed specifically for outdoor installation with all exterior surfaces of phosphatized, zinc-coated steel with primer and baked enamel finish. All components, including accessories shall be contained within the unit.

B. Access to internal components shall be afforded by removable gasketed access panels with quick release latches and lifting handles.

C. Unit shall have factory installed lifting lugs capable of accepting standard lifting slings and spreader bars to facilitate hoisting.

D. Electrical power connections shall be to a single point.

E. Unit shall be insulated with a minimum of 1", 1-pound density glass fiber insulation mat-faced.

F. Unit shall be designed for curb mounting and mate with a full perimeter roof curb for a complete weather tight seal. Curb shall be a minimum of 12" high and manufactured of 12-gauge zinc-coated steel and be supplied by the unit manufacturer with wood nailed strip and gasketing. Unit sides shall overhang the curb to form protective drip lip. Supply and return ducts shall connect to the curb prior to placement of the unit. The manufacturer shall furnish gasketing materials for a leak-tight seal between the unit and cut connections.

2.2 HEATING SECTION

A. Provide aluminum or stainless steel slotted port gas burners and aluminized steel heat exchanger. Warranty on heat exchanger shall be 10 years.

B. Controls shall include redundant gas valve and intermittent pilot with electric spark ignition.

2.3 COMPRESSOR

A. Semi-hermetic reciprocating compressor shall be provided with capacity reduction of a minimum of 50% on units 15 tons and larger. Units smaller than 15 tons shall have hermetic compressors.

B. A crankcase heater shall be provided and wired to be active continuously.

C. The compressor shall be provided with spring isolators and flexible discharge line and hot gas muffler.

D. Motor shall be specifically designed for operation within a refrigerant atmosphere. Inlet screens shall be provided. Motor shall be capable of starting and continuously operating at ambients as high as 120 degrees F. Motor shall have overload protection and internal thermostats.

E. Compressor motor shall be capable of withstanding voltage fluctuations of plus or minus 10% of name plated voltage.

2.4 REFRIGERATION CIRCUIT

A. The unit shall be certified as complying with ARI Standard 210 and bear the ARI seal.

B. The evaporator coil shall consist of 3/8" O.D. copper tubes mechanically bonded to aluminum plate fins and be pressure and leak tested at 425 psig. Condenser fans shall be statically and dynamically balanced. Fan motors shall be UL listed for outdoor use, have built-in thermal overload protection and permanently lubricated bearings. Condensing section shall be designed for a maximum of 130 degrees F condensing temperature with ambient air at 95 degrees F. Coil shall be circuited for subcooling.

C. Unit shall incorporate an insulated and sealed drain pan with threaded drain connections at each end of the unit. The Contractor shall install P-traps.

D. Refrigeration controls shall include as a minimum, high and low pressure control, compressor winding thermostat and overload, lockout circuit re-settable at the unit thermostat, contactors for condenser/evaporator fans and compressor, and 24 volt control power transformer.

E. Unit shall ship with an operating charge of R-22.

2.5 EVAPORATOR FANS

A. Evaporator fan shall be direct driven or belt driven forward curved type with an adjustable sheave and motor sized to meet the air flow and static pressure as scheduled on the Drawings.

B. Fans assembly shall be isolated from the unit on RIS isolators.

C. Motor shall have thermal overload protection and motor and fan bearings shall be permanently lubricated.

D. Fan wheel shall be protected from corrosion with a painted finish.

2.6 ACCESSORIES TO BE PROVIDED (See Schedules on Drawings)

EXECUTION

3.1 EQUIPMENT

A. Unit shall be run tested at factory before shipping.

3.2 INSTALLATION

A. Unit shall be installed level within manufacturer’s recommendations.

B. The Contractor shall install a second set of filters at job completion.

END OF SINGLE PACKAGE ROOFTOP AIR CONDITIONERS

SECTION 23 8128

SPLIT SYSTEM HEAT PUMPS

GENERAL

1.1 DESCRIPTION

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

B. Furnish and install a direct expansion air-to-air heat pump unit of the size and capacity shown on the equipment schedule. The unit shall be completely factory assembled and tested, and shall include compressor, indoor and outdoor coils, stand-by electric strip heating coils, fan motors as required, pre-wired controls, interconnecting refrigerant tubing, wiring, and circuit breakers. Condensing unit shall be factory matched with evaporator coils and air handling unit; units shall be rated in accordance with ARI and UL Listed.

C. Equipment scheduled shall be considered the basis of design for the purpose of describing type, capacity, function and level of quality required. When substitution of equipment is made, the Contractor shall be responsible for the cost of any item and engineering and construction revisions necessary in his or any other contract that may be required to satisfy plans and specification.

D. Acceptable Manufacturers: Carrier, Trane, Lennox, and York.

PRODUCTS

2.1 GENERAL

A. Each unit shall be complete and factory packaged consisting of compressor, condenser coil, stand-by electric heating coil, condenser fans and motors, refrigeration and temperature controls, Unit shall be ARI and UL Listed.

2.2 AIR HANDLER

A. The cabinet shall be complete and constructed of minimum 20-gauge galvanized steel zinc coated and shall be painted with a baked-on powder coating finish. Interior surface of the cabinet shall be lined with a flexible acoustical and thermal insulation and shall be fire proof. Thickness of insulation shall be 1-1/2". Access to fan motor, filters, coils, controls and power supply shall be through the front panel of the unit.

B. The nonferrous direct expansion cooling coil shall be factory mounted and charged with refrigerant. Provide reversing valve, expansion valve, solenoid valve and complete refrigeration circuit. Provide insulated drain pan with exterior primary and secondary drain connection.

C. The air handling unit shall accept a 1" thick high velocity air filter, mounted internally and located upstream of the cooling coil.

D. The blower section shall have an adjustable V-belt or direct drive fan motor with a forward-curved centrifugal type blower mounted on vibration isolators. The fan motor shall have thermal overloads and be permanently lubricated. Direct drive fan motors shall have at least three (3) speeds.

E. An electric resistance heater shall supplement the heat pump operation.

F. The unit shall be supplied with a single point power connection.

2.3 OUTDOOR UNIT

A. The cabinet shall be constructed of galvanized steel with a baked-on enamel finish. Provide with removable access panel at one side of unit to access the compressor, coil, controls, and power supply. Drain holes shall be provided at the base of the unit. Provide fan and coil guards.

B. The compressor shall be the hermetic scroll or reciprocating type, furnished with complete refrigeration circuit(s) including nonferrous condenser coil, receiver, charging valve, refrigerant holding charge, external service valves, compressor anti-cycle protection, internal temperature and current-sensing overloads, crankcase heater, filter/drier, evaporator freeze stat, liquid line solenoid valve, and vibration isolation. Controls shall include over and under voltage protection, high pressure cutout with auto-reset, motor starters and contactors. Compressor shall have a five year warranty.

C. The fan motor shall be permanently lubricated with built-in thermal overload protection.

D. Install unit level as indicated on the Drawings.

E. The unit shall be supplied with a single point power connection.

2.4 CONTROLS

A. Unless noted otherwise, provide a seven-day programmable thermostat with automatic changeover.

B. The thermostat shall prevent the auxiliary electric heat from being energized whenever the heating load can be met by the heat pump.

EXECUTION

3.1 GENERAL

A. Units shall be installed as shown on the Drawings and in strict accordance with manufacturer's recommendations.

B. Units shall be installed level.

C. Units shall be installed to allow adequate service to all components.

END OF SPLIT SYSTEM HEAT PUMPS

SECTION 23 8239

ELECTRIC UNIT HEATERS

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.2 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install electric unit heaters complete as indicated on the Drawings and as specified herein.

PRODUCTS

2.1 UNIT HEATERS

A. Unit shall be of the horizontal or vertical blow-thru propeller fan type.

B. Casing shall be constructed of 18-gauge die-formed, furniture grade steel, phosphate coated and finished in baked enamel.

C. Electric heating element shall be a resistant wire enclosed in a steel sheath with fins.

D. Fan shall be direct drive, propeller type, designed for unit heater application.

E. Motor shall be totally enclosed, thermally protected continuous duty selected to match fan requirements.

F. Unit shall be provided with the manufacturer's standard mounting bracket for either ceiling or wall mounting as required.

G. Unit shall be equipped with individual adjustable louvers.

H. Wiring of unit heater shall be designed for a single source power connection with elements, motor and control circuits subdivided and fused to conform to the latest National Electrical Code, OSHA and Underwriters Laboratories Inc. standards. All three phase heaters shall have balanced phases. A non-fused disconnect switch factory wired shall be provided. Control circuit voltage shall not exceed 120 volts.

I. Unit heater shall be equipped with an automatic reset linear thermal cut-out, a fan delay switch, control circuit transformer and either a wall mounted or unit mounted thermostat as shown on the Drawings.

J. Units shall be Raywall, Q-Mark, Markel or approved equal.

EXECUTION

3.1 INSTALLATION

A. All units shall be installed in strict accordance with the manufacturer's recommendations.

END OF ELECTRIC UNIT HEATERS

SECTION 23 8239.19

ELECTRIC WALL HEATERS

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.2 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install wall heaters complete as indicated on the Drawings and as specified herein.

PRODUCTS

2.1 WALL HEATERS

A. Unit shall be UL Listed, completely factory assembled, wired, tested and shipped as a single assembly. Capacity shall be as indicated on the Drawings.

B. Front grille shall be 16-gauge steel or aluminum finished in baked enamel or anodized with downflow discharge louvers.

C. Element shall consist of helically coiled nickel chromium alloy resistance wire enclosed in corrosion resistant sheaths.

D. Controls shall include fan delay switch, built-in thermostat, automatic reset thermal overload switch and a non-fused disconnect power switch.

E. Unit shall be designed to either recess into the wall or for surface mounting as scheduled, and shall include all mounting accessories.

F. Unit shall be Raywall, Q-Mark, Markel or approved equal.

EXECUTION

3.1 INSTALLATION

A. All units shall be installed in strict accordance with the manufacturer’s recommendations.

END OF ELECTRIC WALL HEATERS

SECTION 26 0000

ELECTRICAL GENERAL

GENERAL

1.1 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work to be done under this section of the specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of systems for power, lighting, signals and all other work indicated on the drawings or as specified herein. A 100% operational building and electrical distribution system up to a connection point for Owner furnished equipment will be provided.

C. The drawings and specifications are complementary to each other and what is called for by one shall be as binding as if called for by both.

1.2 STANDARDS

A. All work shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:
1. The 2008 edition of the National Electrical Code (NFPA 70) with Georgia Amendments
2. The 2006 edition of the International Building Code with Georgia Amendments
3. The 2006 edition of the Life Safety Code (NFPA 101)
4. The National Electrical Safety Code (ANSI C-2)
5. Regulations of the local utility company with respect to metering and service entrance
6. Local city and county ordinances governing electrical work
7. Americans with Disabilities Act (Public Law 101-336)

1.3 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.4 WORK INCLUDED

The electrical systems installed and work performed under this division of the specifications shall include but not necessarily be limited to those listed below. All materials and appliances, obviously a part of the electrical systems and necessary to its proper operation, but not specifically mentioned or shown on the drawings, shall be furnished and installed without additional charge.

A. Power Distribution System

B. All lighting systems (indoor and outdoor, normal, emergency and exit) including all fixtures, lamps, plaster and/or tile frames, standards, switches, outlets, wiring, dimmers, contactors, time clocks, photocells, low voltage relays, batteries, raceways and other components and fittings required for complete lighting systems

C. Wiring, including power circuit connections for HVAC, plumbing and other mechanical equipment

D. Grounding Systems

E. Temporary service lighting and power system

F. Low voltage system raceways and equipment mounting boards as indicated on the drawings

G. Underground raceway excavation, backfill, and compaction

H. Concrete work for duct banks, manholes, covering, lighting standard bases and equipment bases (where not assigned to General Contractor)

I. Lightning Protection System

J. Electrical Equipment Identification

K. Supporting Devices for Electrical Components

L. Work as required by electric and telecommunication utilities, as well as the coordination of additional work (i.e. work performed by the utility) with that of other trades

1.5 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment and conduit. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to rearrange conduit or equipment, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, the Engineer must be advised of the situation before work is advanced to the point where extra costs will be involved.

E. All additional circuit connections to panelboards must be preapproved by the Engineer.

F. The location, arrangement and extent of equipment, devices, conduit, and other appurtenances related to the installation of electrical work shown on drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

G. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering lighting fixtures. Notify the Engineer of any discrepancies.

H. Review all architectural drawings for door swings, cabinets, counters and built-in equipment.

1.6 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Electrical equipment. Manuals shall include copies of control schematics, sequences of operation, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all

manufacturer's drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

1.7 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Contract Drawings that reflect all changes and that accurately show actual final construction, and deliver these drawings to the Architect.

1.8 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment names in specifications or on drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction and capacities. The "equal" equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Submittals for "equal" products shall be made at least ten (10) days prior to bid (refer to the General Conditions of these specifications). The Engineer shall consider the use of the "equal" equipment based on the supportive documentation available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall, in all cases, be final.

D. The Contractor shall coordinate the installation of all electrical equipment proposed for use in this project with all building trades (architectural, structural, mechanical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy the plans and specifications.

E. If substitutions are made in lieu of equipment specified, the manufacturer's literature shall be submitted to the Engineer for approval. In the case of lighting fixtures, full IES photometric test reports for the fixture, lamp(s), and lenses shall be submitted for approval.

1.9 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.

1. Submit a listing of all the materials indicated below, with the type of material, manufacturer and catalog or model number for each (where applicable).
   <u>Package #1</u>
   Conductors
   Wiring Devices and Plates
   Disconnect Switches
   Time Switches
   Photocells
   Lighting Contactors
2. Submit complete shop drawings of the following when supplied by the electrical contractor:
   Package #2
   Fuses and/or Circuit Breakers

Short Circuit and Coordination Study
Switchboards
Transformers
Surge Protective Devices
Panelboards and Cabinets
Package #3
Lighting Fixtures
Occupancy Sensors
Lighting Control Panels
Package #4
Generator Set
Transfer Switch
Package #5
Lightning Protection

3. Submit test reports as required in section 3.7 - Electrical Testing.

B. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of shop drawings by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines at no additional cost.

D. All shop drawings shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

1.10 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Work shall not be performed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated equipment installed should they interfere with the proper installation and mounting of mechanical equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.11 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

1.12 TEMPORARY LIGHT AND POWER

A. The Contractor shall provide a temporary service of the amperage and voltage required by the Project Manager.

B. Sufficient wiring, outlets and lamps shall be installed to ensure proper lighting in accordance with OSHA, state and municipal codes. Refer to Division 1 specifications for requirements.

1.13 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings including mechanical, plumbing and other equipment drawings and other divisions of the specifications for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service.

B. Prior to installing material such as electrical equipment, devices, feeders, or branch circuits serving equipment of all other trades, the Contractor shall coordinate with the electrical requirements of the equipment to be installed.

1.14 MECHANICAL SYSTEMS COORDINATION

A. All control wiring for mechanical systems shall be installed under Division 23.

B. Motor controllers (starters) shall be furnished under Division 23 and installed under Division 26, unless specified otherwise.

C. Power wiring to all motors and motor controllers and between motors and controllers shall be provided in Division 26.

PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. The published standards and requirements of the National Electrical Manufacturers Association, the American National Standard Institute, the Institute of Electrical and Electronic Engineers, and the American Society of Testing Materials, are made a part of these specifications and shall apply wherever applicable.

2.2 IDENTIFICATION

A. Equipment or devices specified in the individual sections to be identified shall be identified by machine cut stencil unless the equipment is identified by the manufacturer. Identification of flush mounted cabinets and panelboards shall be on the inside of the device. Surface mounted equipment shall be identified on the outside cover. Equipment operating on 208Y/120 volt system shall be identified with black labels with white inner core, 480Y/277 volt equipment with white labels with black inner core. Equipment connected to the generator system operating on 208Y/120 volt system shall be identified with red labels with white inner core, 480Y/277 volt equipment with white labels with red inner core.

B. All switchboards and panelboards supplied by a feeder shall be stencil-labeled to indicate the equipment where the power supply originates.

EXECUTION

3.1 GENERAL REQUIREMENTS

A. Mounting heights, unless otherwise noted, are to be center line of the equipment and/or device except the mounting height of suspended light fixtures which is to the bottom of fixture.

B. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.2 EXCAVATION, TRENCHING & BACKFILLING

A. Contractor shall call underground utilities locator company before digging.

B. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.

C. Barriers shall be provided to protect landscaping adjacent to the excavation area.

D. When rocks, concrete or other debris are encountered during excavation, remove completely.

E. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.

F. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.

G. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.

H. Backfill the last 6 inches with clean topsoil.

I. The Contractor shall perform all excavation to install the work herein specified and as indicated on drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling shall be done except under pavement unless approved by the architect..

J. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

K. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 98% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be red for electrical lines and orange for telephone and shall be identified as to the type of line.

L. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.3 STORAGE AND PROTECTION OF MATERIALS

A. Refer to the general requirements section of the specifications, Division 1, for storage, protection, and handling requirements.

B. Inspect materials upon arrival at project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material.

C. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact.

D. Containers which are broken, opened, watermarked, or otherwise damaged materials are unacceptable and shall be removed from premises.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.4 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for electrical equipment where required.

B. Provide 4" thickness housekeeping pads at floor mounted equipment, covering entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.5 PAINTING

A. Except as otherwise specified, painting shall be accomplished under Painting Section. Surfaces shall be left clean of debris and free from oil and other substances which would prevent paint bond.

B. Touch up finishes of factory painted apparatus where finish is marred during installation.

C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.

D. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.6 WORKMANSHIP

A. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components.

3.7 ELECTRICAL TESTING

A. Furnish all labor, materials, instruments, supplies, and services and bear all costs for the accomplishment of the tests herein specified or requested at job site. Correct all defects appearing under test, and repeat the tests until no defects are disclosed, leave the equipment clean and ready for use.

B. All grounds, crosses, shorts, etc., must be eliminated from the wiring. Test all lighting fixtures, together with switches and controls; test the operation of all motors, controllers, and other electrical equipment devices.

C. The switchboard and all feeders shall be Meggar tested. A copy of all test reports shall be given to the Engineer.

D. The Contractor shall perform any tests other than herein specified which may be required by the Engineer or the authority having jurisdiction.

E. Perform the following tests after installation but before energizing the equipment. The following tests and procedures apply to all equipment and material that is to be tested under this Contract.
   1. Transformers
      a. Visually inspect all components for damage, check bushings and insulators for cracks; transformer casing for evidence of leakage; pressure, temperature and liquid level gauges for proper indications. Unit shall be inspected for noise and replaced if deemed excessive.
   2. Ground Resistance
      a. Visually inspect for specified ground connections.
      b. Perform ground resistance test at all connections to switchboards and panelboards.
      c. Use three point or fall of potential method.
      d. Verify single point connection (at the counterpoise) between the grounded and grounding systems.
      e. Additional ground rod is required if resistance is greater than 25 ohms.
      f. Submit report.
   3. Switchboards and Panelboards
      a. Visually inspect all components for damage.
      b. Check operation of circuit breakers/fusible switches.
   4. Ground Fault Systems
      a. Visually inspect for damage and improper connections.
      b. Verify correct operation.
   5. Transfer and Other Relay Schemes
      a. Investigate intended function, and verify correct operation.

F. The Engineer shall be notified immediately of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.

G. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to meet the specified requirements.

3.8 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner's key personnel. These sessions shall be of sufficient length and duration to

adequately explain the design intent and proper operating and maintenance techniques for all equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all equipment and systems.

END OF ELECTRICAL GENERAL

SECTION 26 0519

CONDUCTORS

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.2 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conductors, complete, as indicated on the Drawings and as specified herein. Provide a complete system of wiring with all feeders and branch circuits as shown on the Drawings. The wiring system shall be complete to each and every outlet and apparatus shown on the Drawings which requires electrical connections.

B. This section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts or less.

1.3 COLOR CODING

A. Color coding shall be as follows:

120/208 Volt System	277/480 Volt System
Phase A –Black	Phase A - Brown
Phase B – Red	Phase B - Orange
Phase C – Blue	Phase C - Yellow
Neutral – White	Neutral - Gray
Ground – Green	Ground - Green
Isolated Ground - Green with yellow strip (where applicable)	

(Verify color-coding with local code Authority and use local code requirements if and only if the above color code is not acceptable to local authority.)

B. All wire shall be color coded throughout its entire length. Colored phase tape is not allowed.

PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Wire shall be Southwire/SIMpullTM, Pirelli, Rome, General Cable, Senator, United Copper Industries, Alcan, AFC, or approved equal.

2.2 CONDUCTORS

A. Conductor Material: Unless noted otherwise, conductors shall be copper, 98.5% conductivity except where specifically noted otherwise on Drawings.

B. All wire and cable for feeders and branch circuits shall have copper conductors and shall be 600 volts, 90 degrees C, NEC type conductors with THHN/THWN-2 insulation.

C. Wire No. 8 AWG and larger shall have stranded conductors. Wire No. 10 AWG and smaller shall be solid conductor type.

D. No conductor shall be smaller than No. 12 AWG unless otherwise specified or noted

E. Branch circuit wiring which supplies more than one fluorescent fixture through the wiring of other fixtures shall be high temperature wire approved for such use.

F. Pulling lubricant is neither required nor allowed for Southwire/SIMpull™ conductors.

2.3 ALUMINUM CONDUCTORS

A. Where substituted for copper conductors, aluminum conductors shall match or exceed copper ampacity.

B. Aluminum conductors shall be compact, Alcan, or Southwire. Conductors shall be AA-8000 series.

C. Aluminum conductors shall not be used for branch circuits, and shall not be installed to any vibrating equipment (e.g. mechanical equipment, transformers, elevators, fire pumps). Minimum rating of feeder size shall be 100 amps.

D. Mechanical screw-type connectors shall comply with the following:
   1. Connectors shall be dual rated (AL7CU or AL9CU) and listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
   2. Using a suitable stripping tool, to avoid damage to the conductors, remove insulation from the required length of the conductor.
   3. Wire brush the conductor and apply a listed joint compound.
   4. Tighten the connection per the connector manufacturer's recommendation.
   5. Wipe off any excess joint compound.

E. For connection to aluminum bus, the following hardware shall be used:
   1. Bolts: Anodized alloy 2024-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
   2. Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
   3. Washers: Flat aluminum alloy 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2.
   4. Lubricate and tighten the hardware as per the manufacturer's recommendations.

F. For connection to copper bus, the following hardware shall be used:
   1. Bolts: Plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to ASTM A-325 or SAE grade 5.
   2. Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B.
   3. Washers: Should be steel, Type A plain standard wide series conforming to ANSI B27.2.
   4. Belleville conical spring washers: shall be of hardened steel, cadmium plated or silicone bronze.
   5. Lubricate and tighten the hardware as per the manufacturer's recommendations.

G. Aluminum conductors shall not be used where expressly forbidden by the local electrical inspections department or plan review board of jurisdiction. The electrical contractor shall verify this requirement prior to bid.

H. Aluminum conductors shall not be connected to equipment which is not UL Listed for aluminum.

2.4 METAL CLAD "MC" CABLE

A. Where allowed by the authority having jurisdiction, the use of metal clad cable is permitted as described below and shall meet all the requirements of the following codes and standards:
   1. Underwriters Laboratories Inc. 83, 1479, 1569, and 1581
   2. National Fire Protection Association NFPA 70, Article 330
   3. All local codes and municipal ordinances.

B. The conductors of the metal clad cable shall comply with Articles 1.3 and 2.2 of this same section.

C. MC cable shall be limited to branch circuits concealed in walls or above ceilings. Unless noted otherwise, metal clad cable may not be run directly into surface-mounted panels, cabinets, switches or other devices. All circuit homeruns shall be installed in conduit and shall be routed from the panelboard to the first branch circuit device.

D. MC cable shall not be allowed for wiring to mechanical equipment.

E. Unless noted otherwise, the metal clad cable shall be **MC** with either a galvanized steel jacket or aluminum interlocked armor, a Mylar assembly covering tape, rated at 90 degrees centigrade, with either a green insulated grounding conductor or MC^{AP} Type MC cable with interlocked armor that is listed and identified for grounding, and rated for a maximum of 600 volts.

F. Where used in a concrete slab, the metal clad cable shall be a **Jacketed Metal Clad and Parking Deck Cable** with a black or gray PVC covering, using solid copper conductors, a Mylar assembly covering tape, rated at 90 degrees centigrade, with a green insulated grounding conductor and rated for a maximum of 600 volts.

G. Refer to National Electrical Code Article 330 for uses not permitted.

H. Cables installed in other than vertical runs through bored or punched holes in wood or metal framing members, or through notches in wooden framing members and protected by a steel plate at least 1/16 inches thick, shall be considered supported and secured where such support does not exceed six (6) feet intervals.

I. Cables containing four or fewer conductors sized not larger than No. 10 AWG shall be secured within 12 inches of every box, cabinet, fitting or other cable termination.

J. Metal clad cable shall not be installed outside the building without written authorization from the Engineer.

K. Metal clad cable shall not be used where exposed in the warehouse.

2.5 ACCESSORIES

A. Wire Joints: T & B “Sta-Kon,” Scotchlok Type “R,” Ideal No. 452 or 453, or Buchanan “B-Cap.”

B. Cable Connectors: Solderless Type O.Z. “circular clamp type” or T & B “lock-tite” appropriate for the particular application involved.

EXECUTION

3.1 PREPARATION

A. Lubricant: No grease, oil or lubricant other than powdered soapstone or approved pulling compound shall be used to facilitate the pulling of wires. Lubricant shall not be used for conductors with SIMpull^{TM} insulation.

3.2 INSTALLATION

A. Complete electrical systems shall be provided as shown on the Drawings and/or as specified herein.

B. Wires shall be pulled without excessive strain to prevent damage to conductor or insulation. Provide pull boxes as required to facilitate pulling of wire.

C. Prior to energizing, all service and feeder cables shall be tested with megohm meter to determine insulation resistance levels. Test report shall be submitted to the Engineer.

D. Each raceway indicated by symbol on Drawings shall contain three (3) No. 12 AWG wires unless otherwise noted, scheduled or indicated. Hatch marks on raceway symbols indicate the number of conductors in a raceway when the number exceeds three (3).

E. At each fixture or device outlet, a loop or end of wire not less than 6" long shall be left for connection to fixture or device.

F. Splices, taps and connections shall be made up as follows:
   1. Wire sizes No. 10 AWG and smaller with wire nuts.
   2. Wire and cable of sizes No. 8 AWG and larger, with insulated mechanical or crimped connectors.

G. Perform conductor tests as described in Section 26 0000 - Electrical General.

END OF CONDUCTORS

SECTION 26 0526

GROUNDING

GENERAL

1.1 DESCRIPTION

A. The work required under this section of the Specifications consists of furnishing, installation and connections of the building grounding system. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be 3-phase, 4-wire grounded wye system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.2 REGULATORY REQUIREMENTS

A. Install a complete grounding system in accordance with the National Electrical Code.

PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All materials shall be new, UL Listed, and bear a UL Label.

C. Refer to Section 26 0519 - Conductors for conductor specification.

2.2 GROUNDING CONDUCTORS

A. Grounding electrode conductor shall be bare or green insulated copper or aluminum conductor sized as indicated on the Drawings.

B. Equipment grounding conductors shall be green insulated conductors sized as indicated on the Drawings. Where size is not indicated on the Drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.

C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.3 PANELBOARDS, TRANSFORMERS, AND DISCONNECT SWITCHES

A. Provide each low voltage distribution and branch circuit panelboard with a copper equipment grounding bar brazed or riveted to the associated enclosures or cabinet and an insulated neutral bar.

B. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.4 DEVICES

A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.5 GROUND RODS

A. Ground rods shall be 3/4" x 10'-0" copper clad steel.

2.6 GROUNDING LUGS FOR LOW VOLTAGE SYSTEMS

A. Grounding Lugs and Hardware
   1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

2.7 GROUNDING BUSBARS FOR LOW VOLTAGE SYSTEMS

A. Grounding Busbar
   1. The grounding busbar shall be made of 1/4" thick solid copper.
   2. The grounding busbar shall be installed with minimum clearance, 1" offsets and 1-1/2" insulators.
   3. The grounding busbar shall accommodate 2-hole compression lugs.
   4. The grounding busbar shall meet or exceed J-STD-607-A requirements.

EXECUTION

3.1 INSTALLATION

A. Ground all non-current carrying parts of the electrical system including raceways, equipment frames and enclosures, outlet boxes, junction boxes, and other conductive material in close proximity with electrical circuits.

B. Service entrance and separately derived electrical systems, grounding electrode system
   1. The grounded conductor(s) of the electrical service serving the premises wiring system shall be connected to the neutral bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the Drawings. Grounding electrode conductors shall be installed rigid, nonmetallic conduit to point of ground connection, unless subject to physical damage in which case it shall be installed in galvanized rigid steel.
   2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity.
   3. Bond together the following systems to form the grounding electrode system. All system connections shall be made to the electrodes as close as possible to the service entrance equipment and each connected at the service entrance equipment neutral bus. Do not connect electrode systems together except at neutral bus.
      a. Cold water piping system
      b. Ground rod system
      c. Rebar in concrete footing
      d. Structural steel metal building frame
      e. Lightning protection system
   4. Ground the neutral of all dry type transformers to either building steel or a common grounding electrode conductor connected to a service ground. Transformers shall be bonded to the nearest available point on the interior water piping system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns.
   5. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the Drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL Listed mechanical ground clamps.
   6. Where there is more than one service to a building or interconnected buildings, services shall be connected by means of a grounding electrode conductor.
   7. Bonding shall be in accordance with the National Electrical Code.

8. Install ground rods where indicated on the Drawings with the top of the ground rods 12 inches below finished grade.
9. Ground the neutral and frame of the emergency generator to building steel and the main electrical service ground rod system. In reinforced concrete structures building steel shall be considered to be reinforcing steel or vertical columns. Make connection to building steel with chemical weld type connector, in a location in unfinished space where the connection will not be subject to physical abuse.
10. Generator ground and neutral connections shall be bonded together.

C. Equipment Grounding Conductor
1. Grounding conductors for branch circuits are not shown on the Drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables.
2. Grounding conductors for feeders are typically indicated on the Drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the Drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.

D. Other Grounding Requirements
1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the “point of grounding” of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as “point of ground.” Terminate conductor by stapling to backboard.
2. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by chemical weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.

3.2 TESTING

A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the “Electrical Testing” section of Section 26 0000 - Electrical General. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within 48 hours of rainfall.

3.3 GROUNDING FOR LOW VOLTAGE SYSTEMS

A. The grounding and bonding system that supports low voltage systems shall be designed in accordance with the recommendations contained in the J-STD-607-A Telecommunications Bonding and Ground Standard.

B. All telecommunications rooms shall be equipped with a telecommunications ground busbar (TGB). Each TGB shall be connected to the building’s electrical ground at the electrical room closest to its proximity.

C. All wires used for communications grounding purposes shall be identified with green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA/EIA-606-A.

END OF GROUNDING

SECTION 26 0530

FIRESTOPPING FOR ELECTRICAL SYSTEMS

GENERAL

1.1 GENERAL REQUIREMENTS

A. Applicable requirements of Division 26 shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Firestopping for Electrical Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Typical firestopping installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful Contractor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.3 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Firestopping Materials.

PRODUCTS

2.1 APPROVED PRODUCTS

A. Approved Firestopping manufacturer(s)
   1. FlameStopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
   2. Tremco Inc. (Firestop Cast in Place Sleeves, Caulks, QuickComm Sleeves, QuickComm Units, Pillows, Putty Pads, Outlet Box Inserts, Silicone, Composite Sheets, Collars, Devices)
   3. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
   4. Hilti (Putties, Caulks, Sealants, etc.)

2.2 TYPES OF PRODUCTS

A. Firestop Products
   1. Intumescent Firestop Sealants and Caulks
   2. Acrylic Firestop Sealant and Caulks
   3. Silicone Firestop Sealants and Caulks
   4. Cast in Place Devices
   5. Firestop Putty, Putty Pads
   6. Outlet Box Inserts
   7. QuickComm Sleeves
   8. TREMstop Straps

9. Firestop Collars
10. Wrap Strips
11. Firestop Mortar
12. Firestop Pillows
13. Accessories: Forming/Damming Materials: Mineral Wool, Backer Rod or other type as per manufacturer recommendation.

B. Firestop Devices
   1. Thru-Wall Fitting (FlameStopper by Wiremold)
      a. The firestop device box shall be constructed of 16-gauge G90 steel.
      b. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375 degrees F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
      c. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16-gauge G90 steel with No. 10-32 screws use to adjust opening size.
      d. The firestop device shall be available for 2" and 4" trade size EMT conduit.
      e. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.
   2. Fire Rated Cable Pathway (STI EZ-PATH)
      a. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0 - 100% cable fill.
   3. Tremco (QuickComm Unit) 24" x 12" or 34" x 18"
      a. Fire rated steel frame with an intumescent channel. UL Tested for large openings with 100% visual cable fill. UL Tested for Concrete Floors, Block Walls, Dry Walls and Hollow Core Floors.
   4. Tremco (QuickComm Sleeve)
      a. Fire rated steel sleeve with an intumescent inner sleeve. UL Tested for Concrete Floors, Block Walls, Dry Walls, Hollow Core and Fluted Decks.

2.3 UL CLASSIFICATION

A. Thru-Wall Fitting: The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814 & ASTM E 84).

B. Threaded, Smooth and Split-Sleeve Firestop Devices: Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number.

C. QuickComm Sleeve: Firestop Sleeve for use in through penetration firestop systems. Shall be tested by Underwriters Laboratories Inc. or a recognized Testing Laboratory for through penetration fire stopping applications.

D. QuickComm Unit: Intumescent Firestopping Unit for use in large openings for firestopping for cables, Fiber optic, Power Control, Telecommunications
   1. Threaded Firestop System
      a. Block Wall - W-J-3049
      b. Dry Wall - W-L-3138
   2. Threaded Firestop System (Vertical)
      a. Slab - F-A-3010
   3. Smooth Firestop System
      a. Block Wall - W-J-3048
      b. Dry Wall - W-L-3137
   4. Split-Sleeve Firestop System
      a. Block Wall - W-J-3047
      b. Dry Wall - W-L-3136

5. Tremco QuickComm Sleeve
    a. Block Wall- C-AJ-0123, C-AJ-2580, C-AJ-3270
    b. Dry Wall- WL-0025, WL-2418, WL-3318
    c. Concrete Floor- C-AJ-0123, C-AJ-2580, C-AJ-3270
    d. Fluted Deck- C-AJ-0123
    e. Hollow Core- C-AJ-0123, C-AJ-2580, C-AJ-3318
6. Tremco QuickComm Unit
    a. Dry Wall- WL-3319, WL-4070
    b. Concrete Floor- F-A-3035, F-A-4006

2.4 FIRESTOPPING SYSTEMS

A. Thru-Wall Fitting Firestop System
    1. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls and provide an L rating of less than 5 cfm. The device shall also be tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

B. Threaded, Smooth and Split-Sleeve Firestop Systems
    1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 and ASTM E 84 (UL 1479) fire tests in a configuration that is representative of field conditions.
    2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

C. Firestopping materials and systems must be capable of closing or filling through-openings created by the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials.

D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

E. Firestopping sealants must be flexible, allowing for normal pipe movement.

F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

H. Firestopping material shall be installed inside the cavity of the wall as shown by the annular space requirements in the UL Tested System.

EXECUTION

3.1 CONDITIONS REQUIRING FIRESTOPPING

A. General
    1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.

B. Through-Penetrations
    1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations
    1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet ASTM E 814 and ASTM E 84 Test requirements.

D. Smoke-Stopping
   1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved for the ASTM E 136 Standards.

3.2 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify that environmental conditions are safe and suitable for installation of firestop products.

C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.3 INSTALLATION

A. General
   1. Through Penetration firestop submittals showing each UL Rated Assembly shall be located in the general Contractor's trailer for Inspection purposes.
   2. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Written documentation stating training done on the specific project shall be supplied to the General Contractor for inspection purposes. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
   3. Apply firestops in accordance with UL Tested Systems, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
   4. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
   5. Seal holes and penetrations to ensure an effective smoke seal. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
      a. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
      b. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction
   1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.4 FIELD QUALITY CONTROL

A. Preconstruction meeting shall take place to address firestopping systems to be installed.

B. Prepare and install firestopping systems in accordance with UL Tested System and manufacturer's printed instructions and recommendations.

C. Follow safety procedures recommended in the Material Safety Data Sheets.

D. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.

E. All areas of work must be accessible until inspection by the applicable Code Authorities.

F. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.5 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

B. Leave finished work in a neat and clean condition with no evidence of spillovers or damage to adjacent surfaces.

END OF FIRESTOPPING FOR ELECTRICAL SYSTEMS

SECTION 26 0533

CONDUIT AND RACEWAYS

GENERAL

1.1 GENERAL REQUIREMENTS

A. This section covers the complete interior and exterior conduit system.

B. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.2 STANDARDS

A. Industry Standards
   1. Underwriters Laboratories Inc. (UL) Publications
      No. 1: Standard for Flexible Metal Conduit
      No. 6: Standard for Rigid Metal Conduit
      No. 467: Standard for Grounding and Bonding Equipment
      No. 651: Standard for Schedule 40 and 80 Rigid PVC Conduit
      No. 797: Electrical Metallic Tubing - Steel
      No. 1242: Standard for Electrical Intermediate Metal Conduit - Steel
   2. American National Standards Institute (ANSI)
      C-80.1: Rigid Galvanized Conduit
      C-80.3: Electrical Metallic Tubing

1.3 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conduits and raceways, complete, as indicated on the Drawings and as specified herein.

B. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers
   1. Metallic Conduit Fittings
      a. Thomas and Betts
      b. Appleton
      c. RACO
      d. Crouse Hinds
      e. Steel City
   2. Support Channel - galvanized
      a. Unistrut
      b. Kindorf
   3. Non-metallic Conduit Fittings
      a. Carlon
      b. Georgia Pipe Company

4. Rigid, IMC or Flexible Conduit
   a. Allied
   b. Republic
   c. Triangle
   d. Wheatland
   e. Youngstown
   f. Southwire
5. Flexible Conduit (PVC Conduit)
   a. Anaconda “Sealtite”
   b. Robroy
   c. Southwire
6. Electrical Metallic Tubing
   a. Steeltubes
   b. National
   c. Wheatland
   d. Allied
   e. Triangle
   f. Youngstown
7. Plastic PVC
   a. Carlon
   b. Georgia Pipe Company
8. Pull Box Manufacturer(s)
   a. Hoffman
   b. OZ Gedney
   c. Or Approved Equal
9. Approved Marker Tape Manufacturer(s)
   a. William Frick & Associates
   b. Or Approved Equal
10. Approved Maintenance Hole/Handhole Manufacturer(s)
    a. Old Castle
    b. Pencell (Handholes Only)
    c. Quazite (Handholes Only)
    d. Or Approved Equal
11. Approved Conduit Plug/Cap Manufacturer(s)
    a. Jack Moon
    b. Or Approved Equal

2.2 CONDUIT FITTINGS

A. Electrical metallic tubing (EMT) couplings and connectors shall be steel. Malleable iron, pressure cast or die cast fittings are not permitted.

B. Fittings and couplings shall be set-screw type and/or compression type per 3.1 12. Steel set screw type for 2.5" conduit and larger shall have 2 screws for connectors and 4 screws for couplings. All connectors shall be insulated throat type.

C. Rigid steel and IMC couplings and connectors shall be standard threaded couplings, locknuts, bushings and elbows. All materials shall be steel. Erickson-type couplings may be used to complete a conduit run.

2.3 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be heavy wall, Schedule 40 PVC.

B. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. PVC conduit for concrete encasement shall be Type DB, UL Labeled for 90 degrees C cables. Fittings shall be Type DB, solvent type, and from the same manufacturer as the conduit.

D. Concrete shall have a minimum strength of 2,500 psi at 28 days.

2.4 CONDUIT SUPPORT

A. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2" and smaller with 1/4" threaded steel rods and use 3/8" rods for 2" and larger.

B. Conduit support channels shall be 14-gauge galvanized channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Conduit straps shall be spring steel type compatible with channel. Channels shall not be painted type.

C. Conduit straps shall be single-hole cast metal type or two-hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

2.5 RIGID METALLIC CONDUIT, INTERMEDIATE METALLIC CONDUIT, AND ELECTRICAL METALLIC TUBING

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Electrical metallic tubing (EMT) shall be steel.

2.6 RIGID METALLIC, INTERMEDIATE METALLIC, AND FLEXIBLE CONDUIT AND FITTINGS

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Flexible conduit shall be steel or aluminum type classified for system grounding.

C. Connectors for flexible conduit shall be insulated throat type rated as suitable for system ground continuity.

D. Flexible conduit used for other than connections to lighting fixtures shall not be less than 1/2" trade size. 3/8" flexible conduit may be used for connection to lighting fixtures when sized according to the National Electrical Code.

E. Flexible conduit used in damp or wet locations shall be liquid tight.

2.7 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.8 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes
   1. Maintenance holes shall be pre-cast or cast in place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
   2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
   3. Maintenance holes shall be equipped with grounding busbar.
   4. Maintenance holes shall be equipped with racking for cable storage.
   5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.

6. The cover for electrical maintenance holes shall have the lettering, “POWER” or “ELECTRIC.”
7. The cover for low voltage maintenance holes shall have the lettering, “COMMUNICATIONS.”

B. Handholes
1. Handholes shall be non-conductive and shall not require grounding for safety. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
2. Handholes shall be equipped with racking for cable storage.
3. Electrical handholes shall have the word “POWER” or “ELECTRIC” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
4. Low voltage handholes shall have the word “COMMUNICATIONS” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
5. Handholes shall be able to withstand 10,000 lbs minimum.
6. See Drawings for handhole dimensions and locations.

2.9 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps
1. Conduit plugs shall provide a watertight seal at expose ends of conduits.
2. Conduit plugs shall be conduit size specific.

EXECUTION

3.1 INSTALLATION

A. General
1. Minimum size for electrical conduits shall be 1/2" trade size.
2. Minimum size for low voltage conduits shall be 3/4" trade size.
3. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the drawings. Conduits in the warehouse area can be run exposed in a neat workman-like manner.
4. Leave all empty conduits with a 200 pound test nylon cord pull line.
5. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
7. Protect conduits against dirt, plaster, and foreign debris with conduit caps or plugs, which shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage, any damage conduits shall not be used and are to be replaced.
8. All feeder conduits shall be cleared of any dirt, foreign debris, etc.
9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a Contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
10. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer’s recommendations and architectural specifications.
11. Seal all conduits entering building from below grade, all conduits entering refrigerated spaces i.e. freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture.
12. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeders cables, unless indicated otherwise on the drawings.

13. Conduit fittings shall be set screw type for dry, indoor environments. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments or wet locations.
14. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members.
15. Support conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, fitting, panelboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
16. Attach feeder conduits larger than one inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
17. Where conduits must pass through structural members obtain approval of Architect.
18. Install all conduits or sleeves penetrating or routed within rated fire walls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
19. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
20. Keep raceways at least 6 inches away from parallel runs of flues and hot-water pipes. Install horizontal raceway runs above water piping.
21. Telephone and signal system raceways: 2" trade size and smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

B. Uses Permitted
1. Conduits installed within concrete floor slabs which are in direct contact with grade or which penetrate the building roof shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC) or Schedule 40, heavy wall PVC, or electrical non-metallic tubing (ENT).
2. Conduit run exterior exposed: Galvanized rigid steel (GRS) or intermediate metal conduit (IMC).
3. Conduits in direct contact with earth shall be Schedule 40, heavy wall PVC. Elbows for underground conduits greater than 200' in length shall be galvanized rigid steel (GRS), or electrical metallic tubing (EMT) if elbows are concrete encased. Service entrance conduits installed exposed, or concealed in walls or above ceilings, shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Unless indicated otherwise, service entrance conduits shall be installed “outside” of the building as defined by the NEC. Provide concrete encasement where required or as indicated on drawings.
4. All other conduit, unless specified herein, not permitted in accordance with the NEC, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete or below grade. Feeder or branch circuit conduits that emerge from a floor slab in an exposed location shall be galvanized rigid steel (GRS), electrical metallic tubing (EMT) or intermediate metal conduit (IMC). Where conduits emerge from a floor slab in a concealed location (a wall cavity or above ceiling), PVC elbows are permitted, provided that a conduit adaptor for steel conduit is installed at the nearest point at the slab.
5. Use flexible conduit for connections to motors, dry type transformers, unit heaters, battery charging equipment, water heaters flush mounted lighting fixtures, and any vibrating equipment.
    a. Flexible conduit used for connection of motors, dry type transformers, unit heaters, and battery charging equipment shall not exceed 36 inches in length.
    b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.

c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
d. Flexible conduit installed within plenum spaces shall be limited to lengths not exceeding 4 feet.
e. Liquid tight flexible conduit shall be used to connect equipment in exterior, damp or wet locations.

6. All conduit from the fire pump controller to the fire pump shall be either galvanized rigid steel (GRS) or liquid tight flexible conduit.

C. Below Grade Raceway Installations
1. Install top of conduits 2 inches minimum below bottom of building slabs.

D. Raceway Installations within Concrete
1. Conduit shall be run following the most direct route between points.
2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
3. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduit shall not be run directly below and parallel with load bearing walls.
4. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
5. Provide expansion fittings in all conduits that pass through building expansion joints.

3.2 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

3.3 MAINTENANCE HOLES/HANDHOLES

A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.

B. Tops of maintenance holes/handholes shall be level with the existing grade.

C. Ducts should enter as perpendicular to the wall surface as possible.

D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.4 CONDUIT PLUGS/CAPS

A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.

B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

3.5 ADDITIONAL REQUIREMENTS FOR INTERIOR LOW VOLTAGE CONDUITS

A. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

B. Communications conduit system shall contain no condulets (also known as an LB).

C. Rigid metal conduit (RMC) or intermediate metal conduit (IMC) shall be used for entrance conduits that exceed 50 feet into the building.

D. Horizontal Conduits
   1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
   2. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
   3. Each horizontal home-run conduit can serve from one (1) to three (3) outlet boxes. For one (1) outlet box, a 3/4" conduit shall be used, minimum. For two (2) outlet boxes, a 1" conduit shall be used, minimum. For three (3) outlet boxes, a 1-1/4" conduit shall be used, minimum.

3.6 REQUIREMENTS FOR OUTSIDE PLANT LOW VOLTAGE CONDUITS

A. Duct Banks
   1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes/handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
   2. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
   3. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
   4. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.
   5. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
   6. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
   7. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.
   8. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
   9. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
   10. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
   11. Ducts shall be identified in the maintenance holes and at both ends.

B. Additional OSP Conduit Requirements
   1. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
   2. Below Grade Conduit Installations
      a. Install top of conduits 24 inches minimum below finished grade.
      b. Install top of conduits 6 inches minimum below bottom of building slabs.
   3. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.

END OF CONDUIT AND RACEWAYS

SECTION 26 0534

OUTLET BOXES AND JUNCTION BOXES

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.2 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install outlet and junction boxes, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made the Contractor shall be responsible for the costs of any item and engineered and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.3 QUALITY ASSURANCE

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

1.4 JOB CONDITIONS

A. Protection: Anchor boxes securely to formwork. Provide necessary protection to prevent entry of concrete.

B. Sequencing, Scheduling: Locations of outlets shown on the Drawings are relative and approximate. Exact locations shall be determined on the job and the outlets accurately set according to the architectural drawings, dimensions, casework kneespace, building conditions, furniture positions and Architect's direction. The right is reserved to change the exact location (10'-0" or less) of any switch, ceiling outlet or other outlet in any room before it is permanently installed without increase in Contract cost.

C. All outlet boxes and junction boxes shall be accessible. Any boxes in non-accessible areas (furred ceilings) shall be set flush with barrier surface at a location approved by the Architect.

PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: National Electric Products Company, Thomas & Betts/Steel City, Appleton or Raco.

2.2 OUTLET BOXES

A. Standard Outlet Boxes: Boxes and covers shall be galvanized steel not less than 1/16" thick and in every instance, of such form and dimensions as to be adapted to its specific use and location, kind of fixtures to be used and number, size and arrangement of conduits connecting thereto and particularly sized to accommodate the number and size of wires to be contained therein.

B. Ceiling outlet boxes shall be 1-1/2" or 3-3/8" deep, 4" octagonal (or 4" square when required due to number of wires). Plaster rings or device covers need not be provided on ceiling boxes. Provide extension rings on ceiling boxes to accommodate number of conductors in box.

C. Wall outlet boxes for toggle switches and convenience outlets shall be 1-1/2" or 2-1/8" deep, 4" or 4-11/16" square. Provide with single-device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

D. Outlet boxes for telecommunication purposes (telephone, data, etc.) shall be 4" x 4" square, 2-1/8" deep. Provide with single device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

E. Junction boxes shall be as specified for ceiling and wall outlet boxes. Provide flat covers on ceiling outlets to match ceiling finish. Provide blank device type coverplates on wall outlets, of same materials as specified for device coverplates in same room or area.

F. Outlet boxes where exposed rigid conduit is used shall be cast ferrous alloy, galvanized or cast aluminum.

G. Covers: Where outlet boxes are to be capped, blank coverplates shall be used.

H. Barriers: Provide barriers between devices operating at different voltages or on separate systems such as normal, critical, or life safety.

2.3 FLOOR BOXES

A. Product Description
   1. Floor boxes for receptacles and telephone/data outlets shall be rectangular, non-metallic PVC. Boxes shall be suitable for use in slab-on-grade or above grade. Boxes shall include a non-metallic concrete cover to prohibit concrete or debris from entering the box during installation.
   2. Provide number of compartments as indicated on drawings.
   3. Coverplates and flanges shall be brass.
   4. Floor box device covers shall meet UL 514C requirements for scrubwater test standards.

B. Manufacturer
   1. Hubbell PFBRG Series
   2. Walker/Wiremold 880MP Series
   3. Thomas & Betts 640P Series

C. For poke-thru devices, refer to 2.4 D of Section 26 2726 - Wiring Devices.

2.4 PULL AND JUNCTION BOXES

A. Pull and Junction boxes are not completely indicated. They shall be sized and installed where required in accordance with the NEC.

B. Pull and Junction boxes shall be the suitable NEMA type number to match the environmental conditions.

C. Locations of concealed pull and junction boxes shall be indicated on the record as built drawings for Owner's record.

2.5 CABINETS, FITTINGS, BOXES: GENERAL

A. Cabinets shall be in accordance with UL 50, "Electrical Cabinets and Boxes" and NEMA 250, Type 1. Electrical cabinets, boxes and fittings shall be as required for types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

B. Construction shall be sheet steel, NEMA 1 class except as otherwise indicated. Cabinets shall consist of a box and a front consisting of a 1-piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24" apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24" apart and not over 6" from top and bottom of door. For flush cabinets, make the front approximately 3/4" larger than the box all around. For surface mounted cabinets make from same height and width as box. Furnish metal barriers to separate wiring of different systems and voltage, and furnish accessory feet where required for freestanding equipment.

C. Fasteners for general use shall be corrosion resistant screws and hardware including cadmium and zinc plated items.

D. Fasteners for damp and wet locations shall be stainless steel screws and hardware.

E. Exterior finish shall be gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted interior finish, where indicated, shall be white baked enamel.

G. Fittings for boxes, cabinets, and enclosures shall be in accordance with UL 5148 and shall be zinc plated steel for conduit hubs, bushings and box connectors.

2.6 UNDERGROUND PULL/JUNCTION BOXES

A. Unless noted otherwise, underground enclosures shall be fiberglass, open-bottom and sloped-wall. Covers shall be polymer concrete. Boxes shall be installed in areas expected to experience only light incidental, non-deliberate vehicular traffic (including that from mowers).

B. Enclosures shall meet the load requirements and three-point test procedures specified in the industry standard ANSI SCTE 77 2007. Enclosures shall meet the Tier 8 cover load test (for light traffic) of 12,000 lbs. over a 10" x 10" plate.

C. Manufacturer's guidelines shall be followed for installation, including 6" gravel bed beneath box for stability and drainage. Concrete collar shall be poured around enclosure to protect the ring and top from impact due to soil erosion.

D. Manufacturer
   1. Highline Products
   2. OZ-Gedney

EXECUTION

3.1 INSPECTION

A. The location of all wall outlets, including light fixtures, receptacles, switches, etc., shall be checked to see that the outlet will clear any wall fixture, shelving, work tables, sinks, baseboard and fin type convectors, bulletin boards, etc., that will be installed.

B. Exact locations of outlet boxes shall be coordinated with other trades so that outlet will not be covered by ductwork, piping, etc.

C. The approximate locations of outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

3.2 PREPARATION

A. Architectural Placement: Outlets occurring in architectural features shall be accurately centered in same. Space wall switch outlets equidistant from door trims on the strike side of doors as actually installed so that coverplate clears trim. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on architectural elevations.

B. Install all outlet boxes in finished areas flush with wall or ceiling finish. Maintain 1/4" or less space between outlet box front and finish wall surface.

C. All switches at same level shall be installed on one horizontal line as shown on the Drawings.

D. Wall mounted controls, including temperature controls, in a room shall be grouped at the same location and at same mounting heights.

3.3 INSTALLATION

A. At all concealed outlets for electric lights, switches, wall receptacles, etc., standard outlet boxes and plaster rings shall be provided.

B. Outlet boxes shall be firmly anchored in place and shall be provided with approved fixture studs where required. Outlet boxes shall not depend on the coverplate to hold it secure to the wall.

C. Boxes on opposite sides of walls or partitions: Where drawings show back-to-back wiring devices, the devices on opposite sides of the wall shall be offset a minimum of 6". Through-the-wall type boxes shall not be used. Where boxes will be located on opposite sides of walls or partitions located 24" or closer to each other, moldable putty pads shall be installed to completely cover the exterior surfaces of the box within the stud cavity with a ball of putty material used to plug the end of each conduit at its connection to the box. These pads shall be of the CLIV type and manufactured by one of the following manufacturers:
   1. Minnesota Mining and Manufacturing Co.
   2. Nelson Firestop Products
   3. Specified Technologies, Inc.

D. All holes cut through new or existing smoke or fire partitions shall be sealed. Sealant shall be 3M Brand Fire Barrier System or approved equal. Seals shall be installed in accordance with manufacturer’s recommendations.

E. All flush boxes in rated walls that are larger than 16 square inches in area shall be backed as follows: 1-hour wall - 1 layer of 5/8" gypsum board; 2-hour rated wall - 2 layers of 5/8" gypsum board. Gypsum shall be fire code and attached to outside surfaces of box(es).

F. Cast aluminum, threaded hub type boxes with gasketed weatherproof covers shall be used for wet locations where box is surface mounted.

G. Location of floor boxes indicated is approximate. The Contractor shall refer to the final furniture layout or request field instructions for the exact location. Consult the Architect prior to installation.

H. For outlet and junction boxes installed within grout-filled walls, boxes shall be sealed externally with duct tape to prevent entry of concrete into boxes.

END OF OUTLET BOXES AND JUNCTION BOXES

SECTION 26 0535

LOW VOLTAGE BACKBOARDS

GENERAL

1.1 GENERAL REQUIREMENTS

A. Applicable requirements of Section 26 0000 - Electrical General shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to backboards.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and/or on the Drawings.

1.2 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all backboards.

PRODUCTS

2.1 APPROVED PRODUCTS

A. Approved Equipment Backboard Manufacturer(s)
   1. Hoover – ¾" Pyro-Guard
   2. Standard ¾" Plywood (treated with fire-retardant paint)

EXECUTION

3.1 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

END OF LOW VOLTAGE BACKBOARDS

SECTION 26 0923

OCCUPANCY SENSORS

GENERAL

1.1 WORK INCLUDED

A. The Contractor's work shall include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. The Contractor/supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

C. The Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

1.2 EQUIPMENT QUALIFICATION

A. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

B. All components shall be UL listed, offer a 5-year warranty and meet all state and local applicable code requirements.

C. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

D. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.3 SYSTEM DESCRIPTION

A. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. The Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The supplier's obligation shall include repair or replacement, and testing without charge to the Owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the Owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.4 SUBMITTALS

A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

B. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor.

C. Submit any interconnection diagrams per major subsystem showing proper wiring.

D. Submit standard catalog literature which includes performance specifications indicating compliance to the specification.

E. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

1.5 SYSTEM OPERATION

A. It shall be the Contractor's responsibility to make all proper adjustments to assure Owner's satisfaction with the occupancy system.

1.6 ACCEPTABLE MANUFACTURERS

A. The Watt Stopper, or Pre-Approved Equal: For pre-approval, provide all the information listed under section 1.4 A and 1.4 D a minimum of ten (10) working days prior to initial bid date.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors which meet or exceed the specifications included herein.

PRODUCTS

2.1 GENERAL

A. All products shall be Watt Stopper product numbers.
   1. Ceiling Sensors: WT-605, WT-600, WT-1105, WT-1100, WT-2205, WT-2200, WT-2250, WT-2255, W-500A, W-1000A, W-2000A, W-2000H, WPIR, DT-200, DT-205, CX-100, CX-105, CI-200, CI-205.
   2. Wall Sensors: WI-200, WS-120/277, WA-100, WD-170, WD-180, WD-270, WD-280.
   3. Power and Slave Packs: B120E-P, B277E-P, C120E-P, C277E-P, S120/277-P, AT-120.
   4. HID Control: DM-100.
   5. Outdoor Sensors: EW-100, EW-200, EN-100, EN-200.
   6. Low Temperature: CB-100.
   7. InteleSwitch: TS-200, TS-300, TS-200-24.

B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1,200 watts at 277 volts and shall have 180 degrees coverage capability.

D. Wall switch products shall utilize Zero Crossing Circuitry, which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

G. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0 mm thickness. Products utilizing a soft lens will not be considered.

H. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

I. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.

J. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

K. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

L. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

M. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

N. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

O. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within + 0.005% tolerance, 32 kHz within + 0.002% tolerance, or 40 kHz + 0.002% tolerance to assure reliable performance and eliminate sensor crosstalk. Sensors using multiple frequencies are not acceptable.

P. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

Q. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

R. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Setting shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

S. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

T. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

U. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

V. All sensors shall have UL rated, 94V-0 plastic enclosures.

W. Outdoor motion sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1571 ratings.

X. EW-100 outdoor sensors shall cover up to 35 feet, with a field of view of 180 degrees. EW-200 outdoor sensors shall cover up to 52.5 feet, with a field of view of 270 degrees. EN-100 outdoor sensors shall cover up to 35 feet, with a field of view of 90 degrees. EN-200 outdoor sensors shall cover up to 100 feet, with a long range lens view.

Y. EWF outdoor sensors shall include polycarbonate lamp holders that accept PAR 20 or 38 lamps up to 150W per lamp.

Z. Outdoor sensors shall have an operating temperature range of -40 degrees F to +130 degrees F.

AA. To ensure complete protection from weather elements and exposure, outdoor sensors shall be manufactured with precision double-shot tooling and contain internal silicon gaskets.

2.2 CIRCUIT CONTROL HARDWARE – CU

A. Control Units: For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to minimum of two (2) sensors.

B. Relay Contacts shall have rating of:
13A - 120 VAC Tungsten
20A - 120 VAC Ballast
20A - 277 VAC Ballast

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

EXECUTION

3.1 INSTALLATION

A. It shall be the Contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 to 100% coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The Contractor shall provide additional sensors if required to properly and completely cover the respective room.

B. It is the Contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The Contractor shall also provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

END OF OCCUPANCY SENSORS

SECTION 26 0943

LIGHTING CONTROL SYSTEM – RELAY PANELS

GENERAL

1.1 INTRODUCTION

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. The Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

A. Install a low voltage switching system consisting of relay panels and intelligent switches connected together by a dataline, as well as all associated wiring.

B. The system includes a DIN rail-mounted automation module, photocontrol module and/or other low voltage control devices. These devices are totally compatible with the manual operation of the dataline switches.

C. Requirements are indicated elsewhere in the specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation of control equipment and wiring.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall be ISO 9001 certified.

B. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.

C. System Support: Factory applications engineers shall be available for telephone support.

D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.

E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL Approvals: Remote panels are to be UL Listed under UL 916 Energy Management Equipment.

G. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

1.4 SUBMITTALS

A. Shop Drawings: Submit dimensional drawings of all lighting control system components and accessories.

B. One-Line Diagram: Submit a one-line diagram of the system devices and cabling.

C. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, low voltage dataline switches, occupancy sensors and daylighting controls.

1.5 MANUFACTURERS

A. Acceptable manufacturers for lighting control system are Watt Stopper, Lighting Control & Design, Leviton and Square D Clipsal.

MATERIALS AND COMPONENTS

2.1 SMARTWIRED SWITCHING (SWS) RELAY PANELS

A. Description: Modular Relay Panels shall be UL Listed and consist of the following:
   1. Tub: Empty NEMA 1 enclosure that can accept an interior sized to accept up to 12, 24, or 48 mechanically latching relays.
   2. Power Supply: As required
   3. Cover: Surface or flush as required, with captive screws in a hinged, lockable configuration.
   4. Interior: Interiors shall be provided with up to 12, 24, or 48 installed and tested relays as shown on the Drawings.
   5. Panel shall be provided with provisions for additional components, data connections, etc.

B. Features
   1. Relays shall be momentary-pulsed mechanically latching contactors with plug in connector. Relays shall have mechanically latching contacts with single moving part design for improved reliability. Relays will have the following characteristics:
      a. Coil
         1) Magnetically held, momentary coil activation (50 milliseconds).
         2) 2.2 VA max per relay to allow up to 20 relays to be controlled in parallel using class 2 wiring.
      b. Power Contacts
         1) 20 amp tungsten and NEMA electronic ballast rated.
         2) Rated for 50,000 ON/OFF cycles at full load.
         3) Support #10 - #14 WG solid or stranded wire.
         4) 120, 277 and 347 volt rated.
         5) Standard 1 year warranty.
      c. 30 VAC isolated contacts for status feedback and pilot light indication.
      d. FCC approved for commercial and residential use.
   2. Next to each relay shall be an individual override button and a bi-color LED to indicate status.
   3. Panels shall support the “blink warning” function, with LED indication for each relay.
   4. Captive screw terminations will be provided for all wiring connections.
   5. Each channel button’s dry control contact input terminal shall accept either 2 or 3-wire, maintained or momentary inputs. They shall also accept a 2-wire toggling input.
   6. Each channel shall also have an associated 1 amp, 30 VDC isolated contact which may be used for status feedback or pilot light control.
   7. The unit shall provide LED status indication of the power supply status. Access to 24VAC and 24V rectified power for accessory devices shall be provided within the panel.
   8. The panel shall have an integrated DIN rail for mounting dataline control modules.

2.2 NETWORK DATALINE

A. Description
   1. The intelligence in multiple panels shall be linked over a single dataline.
   2. The dataline, in addition to linking together multiple relay panels, shall be capable of extending out from the electrical closet, and provide a single communications bus to allow dataline switches to communicate with the panels.
   3. The dataline can also connect to a single network clock or a single BMS interface module mounted in the interior of a relay panel or a separate enclosure.

B. Features
   1. Dataline shall be 18 AWG, 4 unshielded copper conductors (two independent twisted pairs) meeting Class 2P NEC code requirements. The dataline can be run in a loop, serial, or star configuration. Minimum 1 turn per 3 inches; capacitance 30pF/foot max.
   2. Maximum length for all dataline wire in the system is 1,500 feet without repeaters.
   3. Maximum number of dataline devices (panels/switch units/controllers) is 64 without a repeater.

2.3 IDENTIFICATION

A. Description
   1. To allow individual overrides, dataline switches shall be terminated to each panel's 4-wire local dataline. Switches shall be available in single, dual, quad, or octal (1-button, 2-button, 4-button, or 8-button) designs. The single, dual, and quad devices shall mount in a standard single gang box; the octal version in a two-gang box.
   2. Each button in a switch module can be individually programmed. Each button can control any one of the following options:
      a. Any individual relay in any single panel.
      b. Any group of relays in any single panel.
   3. For special applications see Drawing notes.

B. Features
   1. Provide switches as shown on the Drawings for overrides, and programmed for specific applications such as:
      a. Blink notice
      b. Cleaning Scenario
      c. Parallel operation
   2. Back Lit LEDs as required

2.4 SMARTWIRED PHOTOCONTROL MODULE

A. Description
   1. A single photocell shall be mounted in an appropriate location for measuring exterior light levels. The sensor shall connect to a separate photocontrol module via the local dataline, which provides power to the unit. No extra wires shall be required.
   2. The photocontrol module shall be designed to integrate seamlessly with either the network clock or the BMS interface module.
   3. The photocontrol module shall measure the actual exterior light level. Each of the eight global channels shall have the ability to be assigned a different trip level.

2.5 BMS INTERFACE MODULE

A. Description: The BMS interface module shall be used in lieu of the network clock to provide the same lighting control functions (with the exception of the astronomic function), but shall allow an external automation device to provide the signal that changes channel status from "occupied" to "unoccupied" (after-hours).

B. Features: Automatically detects the presence of the photocontrol module on the dataline and adds the dark scenarios to the menus, accepting actual light level readings for the following scenarios:
   1. Dark ON/Dark OFF
   2. Dark ON/Schedule OFF

2.6 TELEPHONE CONTROL MODULE

A. Description: The telephone control module shall allow building occupants to override the lighting on or off using a touch-tone telephone.

2.7 UNIVERSAL SWITCH INTERFACE MODULE

A. Description: Provide a universal switch interface module to wire non-dataline switches to the SWS network or to accept contact closures from other systems.

2.8 AUTOMATIC CONTROL SWITCH

A. Description
   1. The automatic control switch shall be a line voltage, push-button wall switch capable of ON/OFF manual operation and also of receiving control signals through the temporary interruption of power to the circuit via the relay panel.
   2. Occupants shall have a five-minute time delay to press the switch, keeping the lights on until the end of the next sweep interval.

B. Features
   1. 120 VAC or 277 VAC models with matching wall plate included.
   2. Audible beep during time delay can be enabled or disabled without removing the switch face plate.
   3. Locator LED.

2.9 ACCESSORY ENCLOSURE

A. Description: Provide an Accessory Enclosure with integral DIN rail mounting area and connections for dataline and optional power supply as needed for remote mounting of intelligence modules.

EXECUTION AND SUPPORT SERVICES

3.1 INSTALLATION

A. Dataline switches and/or photocells shall be mounted in the spaces as indicated on the Reflected Ceiling Plans. Each low voltage wire shall be labeled clearly indicating which relay panel it connects to. Use only properly color-coded, stranded #18 AWG (or larger) wire as indicated on the Drawings. All relays and switches shall be tested after installation to confirm proper operation, and all connected loads shall be recorded on the relay schedule for each panel.

B. The relay panels shall be mounted in electrical closets as indicated on the Drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the Drawings. All power wiring will be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel's designation.

3.2 CONTRACTOR PROVIDED INFORMATION

A. The Contractor shall provide system documentation after the equipment has been installed.
   1. Relay Panels: Panels shall be numbered consecutively beginning at #01 as shown on the Drawings. Individual relay load descriptions and the channels to which they are smartwired shall be recorded on the SWS Relay Schedule form provided with each panel.
   2. Intelligent Dataline Switches: Each intelligent switch on a relay panel's local dataline shall be numbered consecutively beginning with #01. This switch designation shall be recorded on the label provided on the front of the switch unit, under the wall plate. (For example, the switches connected to relay panel #02 would be numbered 02-01, 02-02, 02-03, etc.). The relays (or channels) controlled by each switch shall be recorded on the "SWS Switch Documentation" from provided with the relay panel.
   3. Network Clock (or BMS Interface): The automation scenarios and operating data for each of the eight channels shall be recorded on the "Network Clock Automation Scenarios" form or "BMS Interface Automation Scenarios" form provided with the network clock or BMS interface module.

4. System installation and operation manual shipped with the network clock or BMS interface module shall be provided to the Owner.

3.3 DOCUMENTATION

A. Manufacturer shall provide system documentation including:
   1. System 1-line showing all panels, number and types of switches and sensors, dataline, and network timeclock of BAS interface unit.
   2. Drawings for each panel showing hardware configuration and numbering.
   3. Panel wiring schedules.
   4. Typical wiring diagrams for each component.

3.4 WARRANTY

A. Manufacturer shall provide a 1-year warranty for all system components.

3.5 SYSTEM STARTUP

A. Manufacturer shall provide a factory authorized to confirm proper installation and operation of all system components.

3.6 TRAINING

A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the lighting control system.

END OF LIGHTING CONTROL SYSTEM – RELAY PANELS

SECTION 26 0963

LIGHTING CONTROL SYSTEM – nLight

GENERAL

1.1 INTRODUCTION

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. The Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.

B. The system shall not require any centrally hardwired switching equipment.

C. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)

D. Requirements are indicated elsewhere in the specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation of control equipment and wiring.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall be ISO 9001 certified.

B. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.

C. System Support: Factory applications engineers shall be available for telephone support.

D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.

E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL Approvals: Remote panels are to be UL Listed under UL 916 Energy Management Equipment.

G. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

1.4 SUBMITTALS

A. Shop Drawings: Submit dimensional drawings of all lighting control system components and accessories.

B. One-Line Diagram: Submit a one-line diagram of the system devices and cabling.

C. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, low voltage dataline switches, occupancy sensors and daylighting controls.

1.5 MANUFACTURERS

A. Acceptable manufacturers for lighting control system are Sensor Switch nLight or equal.

1.6 SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

D. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

E. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

F. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

MATERIALS AND COMPONENTS

2.1 CONTROL MODULE (GATEWAY)

A. Description: Control Module shall be UL Listed and consist of the following:
   1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
   2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
   3. Each control gateway device shall be capable of linking 1500 devices to the management software.

B. Features
   1. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
   2. Device shall automatically detect all devices downstream of it.
   3. Device shall have a standard and astronomical internal time clock.
   4. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
   5. Device shall have a USB port

2.2 NETWORKED SYSTEM OCCUPANCY SENSORS

A. Description
   1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
   2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions.

3. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.3 NETWORKED SYSTEM DAYLIGHT (PHOTOCELL AND DIMMING) SENSORS

A. Description
   1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
   2. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

2.4 NETWORKED SYSTEM POWER (RELAY) PACKS

A. Description
   1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
   2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
   3. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
   4. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.

2.5 NETWORKED SYSTEM RELAY AND DIMMING PACKS

A. Description
   1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
   2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.

2.6 NETWORKED AUXILARY INPUT / OUTPUT DEVICES

A. Description
   1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
   2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.7 NETWORKED LED LUMINAIRES

A. Description
   1. Networked LED luminaire shall have a mechanically integrated control device
   2. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).

2.8 NETWORKED SYSTEM WALL SWITCHES AND DIMMERS

A. Description
   1. Devices shall recess into single-gang switch box and fit a standard GFI opening.

2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

2.9 NETWORKED SYSTEM GRAPHIC WALL STATION

A. Description
   1. Device shall have a 3.5” full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
   2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
   3. Device shall surface mount to single-gang switch box

2.10 NETWORKED SYSTEM SCENE CONTROLLERS

A. Description
   1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
   2. Device shall recess into single-gang switch box and fit a standard GFI opening.
   3. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.

2.11 COMMUNICATION BRIDGES

A. Description
   1. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
   2. All lighting control profiles shall be stored on the network control gateway device and on the software’s host server.
   3. F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
   4. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

2.12 BMS COMPATIBILITY

A. Description
   1. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
   2. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.

EXECUTION AND SUPPORT SERVICES

3.1 INSTALLATION

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
C. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
D. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

3.2 DOCUMENTATION

A. Manufacturer shall provide system documentation including:
   1. System 1-line showing all panels, number and types of switches and sensors and network timeclock of BAS interface unit.
   2. Drawings for showing hardware configuration and numbering.
   3. Panel wiring schedules.
   4. Typical wiring diagrams for each component.

3.3 WARRANTY

A. Manufacturer shall provide a 5-year warranty for all system components.

3.4 SYSTEM STARTUP

A. Manufacturer shall provide a factory authorized to confirm proper installation and operation of all system components.

3.5 TRAINING

A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the lighting control system.

END OF LIGHTING CONTROL SYSTEM – nLIGHT

SECTION 26 2200

DRY TYPE TRANSFORMERS

GENERAL

1.1 DESCRIPTION

A. The work required under this section of the Specifications consists of the furnishing, connection and installation of dry type transformers.

1.2 QUALITY ASSURANCE

A. The requirements of the following standards shall become a part of this Specification by reference:
   1. Underwriters Laboratories Inc. (UL) Publications:
      No. 506, 1561: Transformers (1,000 kVA, 3-phase and below; 167 kVA, 1 phase and below)
   2. National Fire Protection Association (NFPA):
      No. 70: National Electrical Code (NEC)
   3. National Electrical Manufacturers Association (NEMA):
      No. St-20: Dry-type transformers for general applications
   4. American National Standards Institute (ANSI):
      No. C89.2
   5. Energy Policy Act of 2005 - Public Law 109-58

B. Acceptable Manufacturers
   1. General Electric
   2. Square D
   3. Siemens
   4. Eaton

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications to ensure transformer access, clearance minimums, and adequate ventilation are provided.

PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENT

A. Furnish all materials specified herein and indicated on the drawings.

B. All transformers shall be UL Listed and bear a UL Label.

2.2 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Insulation System
   1. Single-phase 25-167 kVA and 3-phase 30-500 kVA: Transformers shall be rated for average temperature rise by resistance of 150 degrees C in 40 degrees C maximum ambient, 30 degrees C average ambient. Transformer insulation system shall be UL rated as 220 degrees C system.
   2. 3-phase 3-15 kVA: Transformers shall be rated for average temperature rise by resistance of 115 degrees C. Insulation system shall be 180 degrees C.
   3. All transformers shall have insulation systems of Class 155 or higher.

B. Sound rating shall comply with NEMA and ANSI standards for kVA rating. Internal vibration dampening shall be provided for all transformers.

C. Single-phase transformers rated up to 15 kVA shall have two (2) 5% full capacity taps below normal rated primary voltage. All other single-phase and all 3-phase transformers shall be provided with six (6) 2-1/2% full capacity taps, two (2) above and four (4) below normal voltage, unless only four (4) 2-1/2% taps, two (2) above and two (2) below normal voltage are standard.

D. Construction/Enclosures
   1. Transformers 30-1,500 kVA: Transformer enclosures shall be ventilated and drip-proof with removable front and rear cover panels. Transformers shall be suitable for floor mounting, unless wall mounting is indicated on the drawings.
   2. Transformers up through 25 kVA: Transformer housings shall be totally enclosed, non-ventilated and drip-proof. Access to wiring compartment shall be permitted via removable panel.
   3. Provide NEMA 3R weatherproof type enclosures where noted on the drawings.

E. Energy efficiency of transformers shall meet the minimum standard as outlined in NEMA TP-1 tables.

F. Core assemblies and the center ground point of the coil secondaries shall be grounded to the enclosure by flexible ground straps. Provide grounding lug at the enclosure bonding location for connection of three conductors: the primary and secondary equipment grounding conductors and the grounding electrode conductor.

G. Transformer coils shall consist of aluminum windings.

EXECUTION

3.1 INSTALLATION

A. Installation shall provide not less than twelve inch clearance from combustible materials and not less than 6" clearance from walls or equipment. Floor-mounted transformers shall be mounted on neoprene, waffle type vibration pads 5/8" thick. Where transformers are mounted on channels angles, transformers shall be bolted to structure with 5/8" thick vibration pad between transformer base and structural channel. 4" thick concrete housekeeping pads shall be used for all floor-mounted transformers.

B. Provide working clearance and full accessibility for transformer as required by the National Electrical Code.

C. Primary and secondary connections to dry type transformers shall be made with flexible conduit.

D. The secondary windings of each dry type transformer shall be grounded in accordance with the National Electrical Code requirements for separately derived electrical systems. Extend a grounding electrode conductor from the transformer grounding lug to the nearest building structural steel and to the nearest available point on the interior water piping system. Connect the primary and secondary feeder, equipment grounding conductors to the grounding lug, also. Refer to the grounding section of these Specifications for additional requirements.

3.2 CLEANING AND ADJUSTMENT

A. Prior to job completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch-up paint scratched surfaces with factory furnished touch-up paint of the same color as the factory applied paint.

END OF DRY TYPE TRANSFORMERS

SECTION 26 2413

SWITCHBOARDS

GENERAL

1.1 DESCRIPTION

A. The work required under this section of the Specifications consists of the installation of all switchboards for use on systems 600 volts and below. All materials and devices which are an integral part of the switchboards shall be provided under this section of the Specifications.

B. Switchboards as specified in these Contract Documents are free standing, dead-front, metal enclosed panels of one or more sections. The overcurrent devices may be individually or group mounted.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers: Products of the following manufacturers, which comply with these Specifications, are acceptable:
   1. Square D
   2. Siemens
   3. Cutler Hammer
   4. General Electric

B. Equipment Dimensions
   1. Dimensions noted on the Drawings are the maximum allowable and shall not be exceeded. Where switchboard(s) of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

C. Coordination
   1. Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications and electrical equipment to ensure access and so that clearance minimums are provided.

1.3 SUBMITTALS

A. Refer to Section 26 0000 - Electrical General for submittal requirements.

B. Shop Drawings: Submit shop drawings to indicate compliance with the Contract Documents.
   1. Include electrical characteristics and ratings for each switchboard with dimensions, mounting, bus material, voltage, bracing, ampere rating, mains, poles and wire connection, and any accessories.
   2. Include bussing diagram indicating each circuit breaker or fused switch position.
   3. Provide a schedule indicating overcurrent device, trip and size, poles, frame type, fuse size and type, or circuit breaker interrupting capacity.

1.4 SHORT CIRCUIT AND COORDINATION STUDY

A. Manufacturer of switchboards and panelboards shall provide a short circuit and coordination study between the main protective devices, feeder protective devices and all downstream protective devices to ensure a coordinated system to the greatest extent feasible. Include this Coordination Study in the shop drawing submittals for the equipment.

B. Overcurrent protective devices shall be selectively coordinated for distribution systems serving emergency and standby loads, as well as those serving multiple elevators, for faults with durations at 0.01 seconds.

1.5 ARC FLASH SAFETY

A. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D, and IEEE 1584 – Guide for Performing Arc Flash Hazard Calculations.

B. Arc Flash Hazard Analysis
   1. Manufacturer of switchboards and panelboards shall provide an arc flash hazard analysis for the electrical distribution system. Include this study in the shop drawing submittals for the equipment.
   2. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
   3. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
   4. The flash protection boundary and the incident energy shall be calculated and reported at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
   5. The arc flash hazard analysis shall include all MV, 575v, and 480v locations and locations in 240 volt and 208 volt systems rated 400 amps and above.
   6. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
   7. The arc flash hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
   8. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
   9. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
   10. The report shall indicate incident energy and flash protection boundary calculations as follows:
       a. Arcing fault magnitude
       b. Device clearing time
       c. Duration of arc
       d. Arc flash boundary
       e. Working distance
       f. Incident energy
       g. Hazard risk category
       h. Recommendations for arc flash energy reduction

C. Arc Flash Warning Labels
   1. Contractor shall field-install arc flash labels on equipment that includes the available incident energy and required personnel protective equipment (PPE).
   2. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
   3. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD,” and shall include the following information:
       a. Location designation
       b. Nominal voltage
       c. Flash protection boundary
       d. Hazard risk category
       e. Incident energy

f. Working distance
g. Engineering report number, revision number and issue date

4. Labels shall be machine-printed, with no field markings.
5. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings:
   a. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided.
   b. For each motor control center, one arc flash label shall be provided.
   c. For each low voltage switchboard, one arc flash label shall be provided.
   d. For each switchgear, one flash label shall be provided.
   e. For medium voltage switches one arc flash label shall be provided.
6. Labels shall be field-installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

D. Arc Flash Training
1. The equipment vendor shall train up to four (4) personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals.

PRODUCTS

2.1 GENERAL

A. Furnish all materials specified herein.

B. The switchboard, circuit breakers, and fused devices shall be UL Listed and bear the UL Label. Where a switchboard is utilized as service entrance equipment, it shall be UL Labeled as suitable for such use.

C. The switchboard(s) shall be suitable for operation on the voltage system indicated on the Drawings.

2.2 STRUCTURE ARRANGEMENT

A. The switchboard(s) shall consist of free-standing, standardized vertical sections bolted together to form a continuous structure.

B. Adequate space for conduit and conductors entering the top or bottom, in accordance with the National Electrical Code, shall be provided without structural interference, conductors shall be safely accessible without disrupting service.

C. The structure and all components shall be finished in the manufacturer's standard corrosive-resistant primer and coating.

D. Unless noted otherwise, switchboard sections shall be front accessible.

2.3 BUS ARRANGEMENT

A. All busses shall be tin-plated aluminum, rated for a 65 degrees C temperature rise above a 40 degrees C ambient. The minimum bus bracing, in RMS-symmetrical-amperes, shall be as shown on the Drawings.

B. A neutral bus bar shall be provided, rated 100% of the main phase bus bar ampacity.

C. The main bus shall be fully rated for the entire length of the switchboard.

D. All non-current-carrying parts of the switchboard shall be grounded through the use of a continuous horizontal ground bus connected to vertical ground busses in each section. Ground

bus rating shall meet or exceed the ampacity of the electrical service grounding electrode conductor(s).

E. An accessible cable termination compartment shall be provided for incoming line termination for main lug only applications. Lugs shall be suitable for terminating the size and quantity of conductors as indicated.

F. All terminal lugs shall be UL Labeled for AL or CU conductors rated for 75 degrees C.

2.4 MAIN PROTECTIVE DEVICE(S)

A. The main protective device(s) shall employ fixed type mounting. The devices shall be individually mounted in the switchboard.

B. Provide fused switch(es)
   1. Switch(es) shall be 600V AC, 50/60 HZ rated and shall be UL Listed for application at 100% of their continuous current rating. The current rating shall be as indicated on the Drawings.
   2. Switch(es) shall be bolted pressure contact, load interrupting, fast-acting stored energy type, fused devices. The contact interrupting capacity shall be 12 times the continuous current rating and 200,000 AIC for the combination of switch and fuse. The switch shall have electrical trip mechanism.
   3. Fast-acting current limiting fuses shall be installed in each ungrounded leg of the switch.
   4. Switch shall be equipped with “blown fuse” protection to automatically trip switch upon loss of any fuse.
   5. Switch shall be equipped with factory installed ground fault sensing system and indication.

C. Provide phase-loss protection
   1. Phase loss protection system shall trip the main disconnect device(s) under single-phase condition or a voltage imbalance of 12% or more.
   2. The system shall <u>not</u> trip on total loss of voltage on all phases and shall have a built-in time delay with a range of 3 - 12 seconds. Capacitor trip component is required.
   3. The system shall be equipped with LED fault indicators installed on the front of switchboard enclosure.

2.5 DISTRIBUTION PROTECTIVE DEVICES

A. Provide molded case circuit breakers
   1. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the Drawings or specified herein.
   2. Circuit breakers 600 amps or less shall be of the quick-make, quick-break, trip-free thermal magnetic type.
   3. Circuit breakers greater than 600 amps shall be of the quick-make, quick-break, trip-free, solid state type. Solid state breaker trip functions shall include adjustments for continuous amperage, long time pickup and delay, instantaneous, and ground-fault pickup and delay.
   4. Circuit breakers shall be bolted to the switchboard bus.
   5. Provide shunt trip device to electrically trip circuit breakers where indicated on the Drawings.

2.6 AUXILIARY EQUIPMENT

A. Identification
   1. Refer to Section 26 0000 - Electrical General for nameplate requirements.

B. Metering
   1. Provide a multi-function, high accuracy digital power metering instrumentation module equipped with an LCD display. The module shall provide measurements for current, voltage and power parameters as follows:

a. Phase currents, phase voltages, average phase current, average phase voltage, amp demand, neutral current, kW, kW demand, kW hours, kVAR, kVAR hours, power factor, and frequency.

C. Provide surge protective devices (SPD) integral to the switchboard assembly complying with the following:
1. SPD shall be listed and component recognized in accordance with UL 1283 and UL 1449 Third Edition.
2. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer's factory as an integral device to the electrical equipment.
3. SPD shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems (L-N or L-G if at service entrance with bonding jumper), and L-L, L-G in DELTA systems.
4. SPD shall be modular in design. Each module shall be fused with a surge rated fuse and incorporate a thermal cutout device.
5. A UL approved disconnect switch shall be provided as a means of disconnect in the switchboard device only.
6. SPD shall meet or exceed the following criteria:
   a. Maximum surge current capability (single pulse rated) shall be 120 KA per mode.
   b. Nominal discharge current rating shall be 20 KA.
   c. MCOV shall not be less than 125% of the nominal system operating voltage.
   d. The maximum ANSI/UL 1449 3rd Edition voltage protection rating for the device shall not exceed the following:

Modes	208Y/120	480Y/277
L-N; L-G; N-G	700	1200
L-L	1200	2000

7. SPD shall have successfully passed ANSI/IEEE C62.41-1991 10 x 1000 µs waveform testing performed by a nationally recognized independent test lab.
8. SPD shall have a minimum EMI/RFI filtering of -50dB at 100 kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.
9. SPD shall be provided with 1 set of NO/NC dry contacts.
10. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

EXECUTION

3.1 INSTALLATION

A. Install switchboard on 3" high concrete pad, the horizontal dimensions of which shall exceed the base dimensions of the switchboard by 3" on all sides.

B. Lace and group conductors installed with nylon tie straps. Only one conductor shall be installed under each terminal. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Un-insulated conductor shall not extend beyond 1/8" from terminal lug.

C. Do not splice conductors in switchboard. Where required, install junction box adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

D. Maintain conductor phase color code requirement described in the conductors and cables section of the Specifications.

E. Switchboard name/designation shall be labeled per the requirements of Section 26 0000 - Electrical General 2.2 A, as well as each individual feeder breaker/fused switch and branch circuit breaker/fused switch.

3.2 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Circuit breaker adjustments shall be performed as directed by the Engineer at projection completion.

END OF SWITCHBOARDS

SECTION 26 2416

PANELBOARDS

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

B. Provide the panelboards indicated on the Drawings complete with overcurrent protection devices and spaces.

C. This section includes panelboards and distribution panelboards and associated auxiliary equipment rated 600 V or less as shown on the drawings.

D. Refer to panel schedule and one-line power diagram on drawings for specific requirements of each panel.

1.2 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install panelboards, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.3 QUALITY ASSURANCE

A. Panels shall be factory assembled.

B. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications and electrical equipment to ensure panel access and so that clearance minimums are provided.

C. Components and installation shall be in accordance with NFPA 70, “National Electrical Code,” NEMA PBI, “Panelboards” and UL67 and UL50.

D. Panelboards and load centers shall be listed and identified for use with 75 degrees C rated conductors.

1.4 SUBMITTALS

A. Refer to Section 26 0000 - Electrical General for submittal requirements.

B. Manufacturers Product Data:
   1. Submit material Specifications and installation data for products specified under Part 2 - Products to include:
      a. Overcurrent protection devices
      b. Panelboards

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the Contract Drawings.

1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
2. Include bussing diagram indicating each bussing overcurrent protection device position.
3. Provide a schedule indicating overcurrent protection device type, trip and size, poles, frame type, interrupting capacity.

PRODUCTS

2.1 MANUFACTURERS

A. Panelboard manufacturer shall be:
   1. Siemens
   2. Square D
   3. General Electric
   4. Cutler-Hammer

B. Coordination panelboard manufacturer (fusible panelboards) shall be:
   1. Cooper Bussman

2.2 GENERAL REQUIREMENTS

A. All panels and overcurrent protection devices shall be UL Listed and bear a UL Label. Where panel serves as service entrance equipment, panel shall bear a UL Label indicating suitability as service entrance equipment.

B. Panels shall be of the dead front safety type.

C. Provide panels complete with factory assembled circuit breakers or fuses connected to the bus bars in the positions shown on the panel schedules.

D. Provide all panelboards fully rated to the A.I.C. ratings noted on the schedules, but not less than 10,000 amperes for 120/208 volt panelboards and not less than 14,000 amperes for 277/480 volt panelboards. All devices in a panelboard shall be rated for the A.I.C. ratings shown for the panelboard.

2.3 BUSSING AND INTERIORS

A. All bus bars shall be aluminum. Main lugs and main overcurrent protection devices shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain a full size grounding bus. All panelboards shall contain a full size insulated neutral bus unless otherwise indicated on the drawings.

B. The neutral and ground bus shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

C. Where designated on panel schedule as “space,” include all necessary bussing, device support and connections. Provide blank cover for each space.

D. Where specified or indicated on the drawings, provide sub-feed lugs adjacent to the mains or feed-through lugs opposite end of mains and increase box heights to provide additional cable bending and termination space. Lugs to be the same size and capacity as mains and rated for aluminum or copper conductor terminations.

2.4 ENCLOSURES

A. Panelboard width shall not be less than twenty inches unless indicated on the drawings (32" minimum for distribution panelboards).

B. Provide concealed captive clamping devices, concealed hinges and chrome lock for all flush mounted panels. Key all panels throughout project alike.

C. Where two section panels are required, both sections shall have fully rated bus, separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims of equal size for each section.

D. Panelboard trims for surface mounted panelboards shall be continuously hinged on one side so that when opened, wiring gutters are completely exposed.

E. Provide a label for each branch circuit, feeder, and main circuit breaker in distribution panels, permanently attached per the requirements of Section 26 0000 - Electrical General, 2.2A.

F. Cabinets, flush or surface mounted as indicated. NEMA PB-1, Type 1 enclosure, except where the following enclosure requirements are indicated:
   1. NEMA 250, Type 3R - Raintight.
   2. NEMA 250, Type 3S - Raintight and dust tight.
   3. NEMA 250, Type 4X - Corrosion-resistant stainless steel enclosure, watertight, dust tight, and resistant to oil and coolant seepage. This type shall be used in kitchen areas.
   4. NEMA 250, Type 12 - Dust tight, dripproof, and resistant to oil and coolant seepage.

G. Enclosure shall be fabricated with galvanized steel. Trims shall have electrostatic applied ANSI gray enamel finish and adjustable indicating trim clamps for securing trim to the enclosure. Screwed-on trims shall not be acceptable. Trim shall have an angle support along the bottom serving as a support between trim and enclosure for safe installation and removal of trim.

H. Exterior Panels: Panelboards mounted outside of building shall be in NEMA type 3R enclosures. Panelboards shall have in addition to the standard specified items the following:
   1. Piano hinge
   2. Seams continuously welded
   3. Rolled lip around door and cabinet
   4. No knockouts or holes
   5. Neoprene gaskets on inside of door
   6. Stainless steel hardware
   7. Drip hood at top above door

2.5 CIRCUIT BREAKERS

A. Interrupting rating of all circuit breakers in panelboards shall have UL rating of not less than the RMS symmetrical amps indicated on the Drawings at system voltage. Series rated devices are acceptable with the following exceptions: devices used in distribution serving emergency, standby and multiple elevator loads (selective coordination).

B. Circuit breakers shall be provided with trip rating and poles as indicated on the drawings or specified herein.

C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.

D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panel boards shall be bolted to the bus.

E. Provide the following special devices and accessories when indicated on the drawings or specified herein.
   1. Ground fault interrupting circuit breakers (GFI) where indicated on the drawings.
   2. Provide handle lock-off device to prevent manually turning off device without removal. Install on all circuit breakers serving exit lighting, egress lighting, fire alarm system, security system.
   3. Provide UL Listed “SWD” switching duty circuit breakers on the devices indicated on the drawings.
   4. Provide shunt trip device for electrically tripping circuit breakers indicated on the drawings.

2.6 FUSIBLE COORDINATION PANELBOARDS

A. Interrupting rating of all fuses in panelboards shall have UL rating of not less than the RMS symmetrical amps indicated on the Drawings at system voltage.

B. Fusible panelboards shall be listed to UL 67.

C. Furnish 10% or minimum of three fuses of each rating and type of fuse installed, in addition to any spares indicated in schedule.

D. Panelboard overcurrent device interrupting ratings shall be fully rated for the maximum available fault current and have a U.L. listed interrupting rating of 300kA and CSA certified interrupting rating of 200kA.

E. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit disconnecting means into a single integrated component.

F. Interiors shall be factory assembled.

G. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses.

H. Bus bars shall be tin-plated copper.

I. Neutrals shall be fully rated.

J. Where equipped with main disconnect, permanently installed lockout means shall be provided on the disconnect for lockout tag procedures.

K. Main disconnect shall be quick-make, quick-break type.

L. Main and Branch Overcurrent Protection
   1. All overcurrent protective devices shall have a minimum U.L. listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
   2. Main overcurrent protective devices shall be 600Vac UL listed minimum 300kA IR and CSA Certified minimum 200kA IR Class J time-delay fuses or Class J performance fuses.
   3. Branch circuit overcurrent protection shall be 600Vac UL listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class J performance fuses.
   4. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all overcurrents up to 200kA.

M. Branch fused disconnects
   1. Device shall have visible ON/OFF indication with colored and international symbol markings.
   2. Device shall provide open fuse indication permanently installed neon indicating light.
   3. Device shall be UL and cUL listed 600Vac/200kA or 125Vdc/100kA voltage/short-circuit current rating, load-break disconnect with amp ratings and number of poles as indicated on the panelboard schedule.
   4. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
   5. Fuse and disconnect shall be interlocked to disallow fuse removal while fuse terminals are energized.
   6. No special tools shall be required for fuse removal.
   7. Devices shall have bolt-on style bus connectors.
   8. Device housing shall be clearly marked with device amperage.
   9. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A and 100A.

EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB1.1, “General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less” and manufacturer’s written installation instructions.

B. Mount panelboards with top circuit breaker not more than 6'-6" above finished floor.

C. Only one conductor installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Un-insulated conductor shall not extend beyond one-eighth inch from terminal lug.

D. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box.

E. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. Panelboards 600 amp and larger shall be secured by a minimum of eight (8) devices. A 1.5 inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installation on steel structure or sheet rock walls.

F. Maintain conductor phase color code requirements described in the conductors and cables section of the specifications.

G. A typewritten branch circuit directory (based on as-built conditions) shall be provided for each panelboard and load center, permanently mounted on inside of door in a transparent, protective cover. Room number(s) or room name(s) shall be included in the circuit description in coordination with the final naming/numbering scheme for the project (e.g. “Office Receptacles” shall read “Office Receptacles – Rm. 202, 203”).

H. Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, “Application Guide for Ground Fault Circuit Interrupters.”

I. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

J. Mounting of all panelboards and all hardware used for mounting shall be in accordance with the seismic criteria per the applicable building code.

K. Fusible coordination panelboards shall be shipped without branch circuit fuses installed. Branch circuit fuses shall be shipped separately with the chassis. Where main fuses are specified 100A or greater, equipment shall be shipped with main fuses installed.

END OF PANELBOARDS

SECTION 26 2726

WIRING DEVICES

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.2 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install wiring devices, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. The following manufacturers are allowed:
   1. Hubbell
   2. Pass & Seymour
   3. Cooper
   4. Leviton
   5. Thomas & Betts/Steel City
   6. Walker/Wiremold

   When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes receptacles, connectors, switches, dimmers, timeclocks and coverplates.

1.3 QUALITY ASSURANCE

A. Wiring devices shall comply with applicable sections of NEMA Standard WD-1, NFPA 70, Article 100.

B. All special purpose receptacles shall be NEMA standard configuration.

C. Comparative devices by acceptable manufacturers are equal.

PRODUCTS

2.1 WIRING DEVICE DESCRIPTION AND MANUFACTURER

A. Single & Duplex Receptacles (20 Amp)
   1. Single or duplex type receptacle as indicated. 125V/20/A/2P/3W/G rating - NEMA - 5-20R type.
   2. Face color shall be **gray** is all warehouse areas and **white** in office areas **(red** where on emergency circuit).
   3. Manufacturer
      a. Hubbell 5362

B. GFCI Duplex Receptacles
   1. Duplex, feed-thru type ground fault current interrupter receptacle with test/reset buttons. 125V/20A/2P/3W/G rating - NEMA 5-20R type conforming to UL #498, UL #943 Class A and NEMA #WD1-4.02.
   2. Manufacturer
      a. Hubbell GF20 Series

C. Maintained Contact Switches
   1. Provide toggle operated switches SPST, DPST, 3-way or 4-way operation as indicated. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, and side wired.
   2. Manufacturer
      a. Hubbell 1221 Series (Color to match receptacles).

D. Slider Type Incandescent Dimmers
   1. Slide operated AC incandescent solid state type dimmer with positive ON/OFF switching, integral surge protection, voltage stabilized output, RFI filtered and maximum lighting level adjustment. 120V/60Hz, unless noted otherwise, with lettering and/or nameplate as indicated. Dimmers shall have lowest profile available (wattage permitting).
   2. Manufacturer
      a. Leviton Monet Series
      b. Lutron Nova T Series

E. Illuminated Toggle Switches
   1. Single pole, 3-way or 4-way, as indicated, conforming to UL #20, NEMA #WDI-3.02 and F.S. #W-S-896E. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, back and side wired. Red colored toggle to glow when switch is on.
   2. Manufacturer
      a. Hubbell HBL 1221PL

F. Weather-Resistant Receptacles
   1. All 15- and 20-amp receptacles installed in damp or wet locations shall be listed weather-resistant type

2.2 COVERPLATE DESCRIPTION AND MANUFACTURER - COVERPLATES

A. Flush Mounted Interior Receptacle/Switch Coverplates
   1. Single or multi-gang to match device type. Medium size (4-7/8" min.), standard depth, smooth finish with nylon material.
   2. Color to match device color.
   3. Coverplates in mechanical/electrical equipment rooms and high abuse areas and throughout warehouse shall be stainless steel, non-magnetic.
   4. Manufacturer
      a. Hubbell NPJ Series (nylon)
      b. Hubbell SS Series (stainless steel)

B. Weatherproof Device Coverplates
   1. Provide weatherproof “in use” cast aluminum lockable covers.
      a. Hubbell WP Series
      b. Thomas & Betts Russell Stoll Series

C. Multi-Outlet Raceway
   1. Product Description
      a. Two-piece rectangular surface raceway of length as prescribed. Stainless steel type 304 housing complete with all bends, fittings, couplings, caps and mounting hardware.
      b. Single 15A/125V grounding outlets UL labeled and full length ground wire.

c. Outlets 18" on centers starting no less than 9" from end.
d. Maximum of six outlets per circuit. Where two or more circuits are utilized the outlets shall be on alternate circuits unless otherwise noted.

2. Manufacturers
   a. Walker/Wiremold
   b. Hubbell

2.3 MISCELLANEOUS ITEMS

A. Time Switches
   1. Electronic Astronomical Schedule Type
      a. 365 day scheduling, solid state, skip-a-day feature, daylight saving changeover, leap year adjusted with capacitor backup, DPDT-120V/20A rated contacts, light sensor input.
      b. Acceptable Manufacturer
         1) Tork DZS Series (channels as required)

B. Photoelectric Control Switches
   1. Product Description
      a. Raintight photoelectric self-contained control for switching.
      b. Die-cast housing with adjustable sensor.
   2. Manufacturers
      a. AMF/Paragon
      b. Tork 2100 Series

C. Lighting Contactor
   1. Product Description
      a. Multi-pole contactor for switching branch circuit tungsten and ballast lighting and resistant heating loads.
      b. Number of poles as indicated (paralleling multiple contactors is acceptable), poles rated for 20 amperes @ 600V continuous duty.
      c. Mechanically held contactor with coil clearing contacts, operating coil voltage to match circuit characteristics.
      d. Housed in panelboard (if indicated).

EXECUTION

3.1 INSTALLATION

A. All dimmer circuits shall have dedicated neutrals.

B. Install devices and wall plates flush and level.

C. Coordinate the exact location of wiring devices with other trades and architectural features. Do not locate devices on two different architectural finishes such as half on wall tile and half on painted surface, unless noted otherwise.

D. Provide plaster rings in areas requiring them due to construction.

E. Where more than one device is indicated, arrange in gangs covered with one coverplate per manufacturer's instructions.

F. Where dimmer(s) and switch(es) are shown adjacent to one another, switch(es) shall be a maintained contact switch matching dimmer style, so that a common, multi-gang faceplate can be used.

G. Provide 6" long ground wire from grounding lug to all switches and receptacles to a screw type bonding device on the conduit or outlet box.

END OF WIRING DEVICES

SECTION 26 2816

DISCONNECT SWITCHES

GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.2 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install disconnect switches, up to 1200 amps, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes fuses.

D. This section includes individually mounted enclosed switches used for the following:
   1. Service disconnecting means.
   2. Feeder and branch-circuit protection.
   3. Motor and equipment disconnecting means.

1.3 SUBMITTALS

A. Product Data: For each type of switch and fuse accessory, and component indicated, include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA AB 1, NEMA KS 1 and UL 98.

C. Comply with NFPA 70.

D. Comply with NEMA FU 1.

E. Source Limitations: Provide fuses from a single manufacturer.

1.5 COORDINATION

A. Coordinate layout and installation of switches and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer of fusible and non-fusible switches shall be Cutler-Hammer, General Electric, Siemens or Square D Company.

B. Manufacturer of fuses shall be Bussman, Gould Shawmutt or Littelfuse.

2.2 ENCLOSED SWITCHES

A. All disconnect switches shall be heavy duty type with lockable handles (general duty allowed for equipment serving dwelling units).

B. Enclosed, non-fusible switch: NEMA KS 1.

C. Enclosed, fusible switch, 800 A and smaller: NEMA KS 1 with clips to accommodate specified fuses and interlocked with cover in closed position.

D. Furnish and install all safety type disconnecting switches indicated on the drawings, specified or required by the National and/or State Electrical Code. Switches shall be externally operable. If the size is not shown on the drawings, the subcontractor shall size the disconnect switch in accordance with name plate data of the equipment they serve.

E. Coordinate with other trades that may provide unit mounted disconnect switches prior to submission of bids.

F. Safety type disconnecting switches shall be heavy duty, 600 volt industrial type with quick-make, quick-break mechanism and interlocking cover which normally cannot be opened when the switch is in the “ON” position. Switches shall be single throw. Fusible switches shall be equipped with fuse clips to receive Bussman fuses. Switches shall have provision for padlocking in the open and closed positions. The operating handle shall be visible in either the on or off position.

G. All fused disconnect switches mounted above 6'-6" shall be hook stick operable.

2.3 INTERIOR

A. Switch blades shall be operated by rotating shaft directly connected to the operating handle mechanism. Switch blades shall be clearly visible in the open position. All switches shall have clear shields over the incoming line lugs. Line shields shall be attached in such a way that switch blade covers or arc shields need not be removed for line installation. Line and load lugs shall be front removable and suitable for copper or aluminum, 60/75 degree wire through 200A sizes, 75 degrees C wire for 400-800A sizes.

B. Current limiting type RK1 dual element time delay fuses shall be furnished and installed as necessary; rating shall be shown on drawing.

2.4 ENCLOSURES

A. All switches shall have NEMA type 1 general purpose enclosures unless indicated otherwise on the drawings. NEMA 3R covers shall be side hinged rather than top hinged. NEMA 1 and 3R switches through 200A sizes shall tangential knockouts for conduit line up against walls. NEMA 12 enclosures through 200A sizes shall be UL listed for conversion to NEMA 3R usage by opening a factory provided drain hole. All types of enclosures shall have metal nameplates affixed to the cover to show the switch type and rating and clearly indicate “ON” and “OFF” direction of handle movement. Provide hubs on all NEMA 4, 4X, or 3R type disconnects.

B. Provide manufacturer’s standard factory applied finish unless otherwise indicated.

C. Provide phenolic engraved nameplate for disconnect switches.

2.5 CONTROL POLE

A. Where required a direct action interlock or control pole shall be affixed to the switch base in such a manner as to operate positively and only with the opening and closing of the switch power poles.

2.6 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate disconnect switches to provide working clearance and full accessibility as required by the National Electrical Code.

B. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5-inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosure shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified. Mount with operating handle at 60" AFF, unless other height is indicated.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device.
      e. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure.

C. Do not splice conductors in enclosure. Where required install junction box or wireway adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

3.3 CONNECTIONS

A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF DISCONNECT SWITCHES

SECTION 26 3213

EMERGENCY STANDBY GENERATOR SYSTEM AND SWITCHING

GENERAL

1.1 DESCRIPTION

A. Provide an emergency standby power system for supply of power in the event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter. System shall comply with NFPA 110 requirements, and the latest requirements of the U.S. Environmental Protection Agency (EPA).

B. Generator shall be rated as indicated on drawings at 30% maximum voltage dip.

C. Provide automatic operation from automatic transfer switch(es) described within this specification so that the system comes on line fully automatically, and after restoration of utility automatically retransfers load to normal power, shuts down the generator and returns to readiness for another operating cycle.

1.2 CODES AND STANDARDS

A. The emergency generator system shall conform to the requirements of the following:
   1. NFPA 110 – Emergency and Standby Power Systems
   2. NFPA 30 – Flammable and Combustible Liquids Code
   3. NFPA 37 – Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines

1.3 MANUFACTURER QUALIFICATIONS

A. This system is designed based upon products of Caterpillar. Kohler, Cummins/Onan, MTU/Detroit Diesel, and Generac are considered to be approved equals provided they meet every portion of this written specification. The manufacturer must be regularly engaged in the production of engine-alternator sets and associated controls for a minimum of ten years, so there is one source of supply and responsibility. The complete engine generator set system shall be supplied by the manufacturer's authorized distributor only.

PRODUCTS

2.1 ENGINE

A. The prime mover shall be a liquid cooled, **diesel fueled**, turbo-charged/after cooled engine of 4-cycle design. The engine shall be a single piece, cast block. Multiple blocks combined are not acceptable. The engine will utilize in-cylinder combustion technology, as required, to meet the applicable EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178-D2 Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder.

B. The engine is to be cooled with a unit-mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in **104 degrees Fahrenheit** (40 degrees Celsius) ambient temperature.

C. The intake air filter with replaceable element must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass and replaceable elements. Engine coolant and oil drain extension must be provided to outside the mounting base for cleaner and more convenient engine servicing. A fan guard must be installed for personnel safety.

D. The engine shall have a battery charging DC alternator with a transistorized voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.

E. Engine speed shall be governed by an **electronic** governor to maintain alternator frequency within **0.5%** from no load to full load alternator output. Steady state regulation is to be + **or - 0.25%**.

F. The engine fuel system shall be designed for operation on No. 2 diesel fuel. A secondary fuel filter, water separator, manual fuel priming pump and fuel shut-off solenoid and all piping must be installed at the point of manufacture. Upon turnover of the project to the Owner, the fuel tank shall be full.

G. The engine shall have an engine-mounted, thermostatically-controlled jacket water heater to aid in quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The Contractor shall provide proper branch circuit from normal utility power source.

2.2 ALTERNATOR

A. The alternator shall be a 4-pole revolving field type, for 3-phase, 60 Hz (voltage indicated on Drawings) with a brushless exciter. The stator shall be directly connected to the engine flywheel to ensure permanent alignment. The generator shall meet temperature rise standards for UL 1446 Class H or better varnish. All leads must be extended into the AC connection panel. The alternator shall be protected by an automatic reset field circuit breaker, or over excitation sensing voltage regulator.

B. Load acceptance shall be 100% of nameplate kW rating and meet the requirements of NFPA 110. The engine-generator set shall be so designed that instantaneous voltage dip upon application of nameplate kW/kVA shall not exceed 30% with recovery to stable operation within 10 seconds. Sustained voltage dip data is not acceptable

C. A solid state voltage regulator designed and built by the engine-generator set manufacturer must be used to control output voltage by varying the exciter magnetic field to provide + **or - 1%** regulation during stable load conditions. Should an extremely heavy load drop the output frequency, the regulator shall have a voltage drop of 4 volts/hertz to maximize motor starting capability. The frequency at which this drop operation begins must be adjustable, allowing the generator set to be properly matched to the load characteristics ensuring optimum system performance.

D. The voltage regulator must contain a limiting circuit to prevent output voltage surges in excess of 110% of rated voltage during generator set operation. On a loss of the sensing signal, the voltage regulator must shutdown to prevent an overvoltage condition from occurring. A voltage regulator that can go into a full field condition is unacceptable. A rheostat shall provide a minimum of + or - 10% voltage adjustment from the rated value.

E. A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. An isolated neutral lug must be included by the generator set manufacturer to ensure proper sizing.

F. The electric plant shall be mounted with vibration isolators on a welded steel base which shall permit suitable mounting to any level surface.

G. Terminal lugs shall be factory-installed for load-side feeder connections.

2.3 CONTROLS

A. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting and a fused DC circuit to protect the controls. It shall provide true RMS sensing to ensure AC metering accuracy to within +/- 1% of rated AC voltage (L-L and L-N) and current.

B. The engine-generator set shall contain a complete engine start-stop control which starts the engine on closing contacts and stops the engine on opening contacts. A cyclic cranking limiter shall be provided to open the starting circuit after five attempts if the engine has not started within that time. Engine control modules must be solid state plug-in type for high reliability and easy service. The engine controls shall also include a 3-position selector switch with the following positions: RUN/AUTO/STOP. A red annunciator lamp shall be energized when the switch is not in auto.

C. Safety shutdown monitoring system shall include solid state engine monitor with individual lights and one common external alarm contact indicating the following conditions: Overcrank shutdown, Overspeed shutdown, High Coolant Temperature (Low Coolant Level shutdown), Low Oil Pressure shutdown. Monitoring system shall include lamp test switch or engine control switch for manual reset of tripped conditions. Engine RPM is to be monitored by an independent permanent magnet sensor. If there is a failure in this circuit, the engine must shut down immediately and illuminate an overspeed condition.

D. Engine control panel instrumentation shall consist of an oil pressure gauge, coolant temperature gauge, DC ammeter and an engine run hour meter located on the unit control panel. Alternator instrumentation must include analog or digital meters to indicate output voltage, amperage, kW, kVA, PF and frequency.

E. Provide the following items installed at the factory:
   1. Pre-alarms for low coolant temperature, high water temperature and low oil pressure must be provided to anticipate possible problems before the system becomes inoperative. Yellow lights labeled on the control panel will illuminate should the associated parameter be exceeded.
   2. Engine battery voltage is to be monitored to detect abnormal voltage levels. A light labeled on the control panel will illuminate should a low voltage condition be experienced.
   3. One alarm horn to actuate upon engine fault shutdown.
   4. Emergency stop button to immediately shut down the engine upon actuation.

2.4 MISCELLANEOUS EQUIPMENT

A. The following equipment is to be installed at the engine- generator set manufacturer's facility:
   1. Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be critical grade. The silencer(s) shall have a flexible, seamless, stainless steel exhaust connection and rain cap. All components must be properly sized to assure operation without excessive back pressure when installed.
   2. The fuel system shall include a **UL Listed, 660-gallon, double wall fuel tank base**. It shall have the structural integrity to support the engine-generator set. Minimum features shall include all welded construction, a lockable fuel filler cap, fuel gauge, low fuel level alarm, **tank rupture alarm**, fuel line check valve and fittings for fuel supply, return, fill and vent. This tank must be supplied and warranted by the engine-generator set manufacturer and be factory installed. The system shall also be equipped with a water separator (Racor or equal). Tank installation shall comply with the Georgia Environmental Facilities Authority (GEFA).

3. Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The automatic battery charger shall be rated no less than 10 amps. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.
4. A heavy duty, lead acid battery set shall be provided by the generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine. Provide all intercell and connecting battery cables as required.
5. Weather Protective Enclosure: The engine-generator set shall be factory enclosed in a heavy gauge steel enclosure constructed with corner posts and powder coated baked finish. The enclosure is to have large, easily opened doors to allow access to the engine, alternator and control panel. Each door is to be fitted with stainless steel, lockable hardware with identical keys. Padlocks do not meet this specification.

B. The following equipment is to be provided by the engine- generator set manufacturer and shipped loose with the unit:
1. Provide a remote annunciator panel for wall mounting. The panel shall have an ALARM switch that when activated silences the audible alarm. A TEST switch must be included to verify the lights are functional. The following alarms shall be included for the remote annunciator:
   a. Overcrank
   b. Low Coolant/Water Temperature
   c. High Coolant/Water Temperature Pre-Alarm
   d. High Coolant/Water Temperature Shutdown
   e. Low Oil Pressure Pre-Alarm
   f. Low Oil Pressure Shutdown
   g. Overspeed
   h. Low Fuel Alarm
   i. Control Switch Not In Auto
   j. Provide a minimum of four (4) spare lights for other potential alarms.
   k. Manual Start Switch
2. Provide a manual breakglass station located on the weatherproof enclosure for shutdown of the generator. Station shall be appropriately labeled.

AUTOMATIC TRANSFER SWITCH

3.1 SCOPE

A. Furnish and install the 4-pole automatic transfer switch(es) with amperage, voltage, and withstand rating as shown on the plans. Each automatic transfer shall consist of a double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

3.2 CODES AND STANDARDS

A. The automatic transfer switch(es) and controls shall conform to the requirements of:
1. UL 1008 – Standard for Transfer Switch Equipment
2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
3. NFPA 70 – National Electrical Code
4. NFPA 110 – Emergency and Standby Power Systems
5. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

6. NEMA Standard ICS10-1993 (formerly ICS2-447) – AC Automatic Transfer Switches
7. UL 508 Industrial Control Equipment

3.3 ACCEPTABLE MANUFACTURERS

A. Automatic transfer switch(es) shall be based on ASCO 7000 Series. Other acceptable manufacturers shall be Russell.

3.4 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

C. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

D. The ATS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.

3.5 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

C. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
1. IEEE472 (ANSI C37.90A) Ring Wave Test
2. ENC55011 1991 Class A Conducted and Radiated Emission
3. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge
4. EN61000-4-3 Radiated Electromagnetic Field Immunity
5. EN61000-4-4 Electrical Fast Transient Immunity
6. EN61000-4-5 Surge Immunity
7. ENV50141 HF Conducted Disturbances Immunity

3.6 ENCLOSURE

A. The ATS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.

3.7 STANDARD FEATURES

A. A three position momentary-type test switch shall be provided for the test/automatic/reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

F. An in-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

G. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
   1. Enable or disable the routine.
   2. Enable or disable transfer of the load during routine.
   3. Set the start time,
      - time of day
      - day of week
      - week of month (1st, 2nd, 3rd, 4th, alternate or every).
   4. Set the duration of the run.
      At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

H. System Status: The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two (2) times. This screen shall display a clear description of the active operating sequence and switch position. For example,
   Normal Failed
   Load on Normal
   TD Normal to Emerg
   2min15s
   Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.

I. Data Logging: The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
   1. Event Logging
      a. Data and time and reason for transfer normal to emergency
      b. Data and time and reason for transfer emergency to normal
      c. Data and time and reason for engine start
      d. Data and time engine stopped

e. Data and time emergency source available
f. Data and time emergency source not available

2. Statistical Data
   a. Total number of transfers
   b. Total number of transfers due to source failure
   c. Total number of days controller is energized
   d. Total number of hours both normal and emergency sources are available.

3.8 ACCESSORIES

A. Provide two double throw contacts that operate when emergency source voltage is present at the switch terminals, ASCO accessory 18B.

B. Provide two double throw contacts that operate when normal source voltage is present at the switch terminals, ASCO accessory 18G.

C. Provide a selective load disconnect circuit (Elevator Contacts) that operates with an adjustable time delay from 1 second to 5 minutes before transfer of the ATS to emergency and resets 1 second to 5 minutes after the retransfer to normal, ASCO accessory 31Z.

D. Provide digital metering for local and remote (MODBus) annunciation, ASCO accessory 85L, with the following metered quantities:
   1. Current, per phase RMS and neutral (if applicable)
   2. Current Unbalance %
   3. Voltage, phase-to-phase and phase-to-neutral
   4. Voltage Unbalance %
   5. Real power, per phase and 3-phase total
   6. Apparent power, per phase and 3-phase total
   7. Reactive power, per phase and 3-phase total
   8. Power factor, 3-phase total and per phase
   9. Frequency
   10. Accumulated Energy (MWH, MVAH, and MVARH)

3.9 CONTROLLER DISPLAY AND KEYPAD

A. A 4-line, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
   1. Nominal line voltage and frequency
   2. Single or three phase sensing
   3. Operating parameter protection
   4. Transfer operating mode configuration
      (Open transition, Closed transition, or Delayed transition)

   All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.10 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout/Trip	Pickup/Reset
Undervoltage	N&E,3Ø	70 to 98%	85 to 100%
Overvoltage	N&E,3Ø	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below drop-out

B. Repetitive accuracy of all settings shall be within 0.5% over an operating temperature range of -20 degrees C to 60 degrees C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

3.11 TIME DELAYS

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on retransfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control.

The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only
2. Prior to and after transfer
3. Normal to emergency only
4. Emergency to normal only
5. Normal to emergency and emergency to normal
6. All transfer conditions or only when both sources are available

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:

1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.12 WITHSTAND AND CLOSING RATINGS

A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The ATS shall be UL Listed in accordance with UL 1008 and be labeled in accordance with that standard's 1.5 and 3-cycle long-time ratings. ATSs which are not tested and labeled with 1.5 and 3-cycle (any breaker) ratings and have series or specific breaker ratings only are not acceptable.

3.13 SERVICE REPRESENTATION

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

C. The automatic transfer switch(es) shall be supplied by the generator set distributor in order to establish and maintain a single source of system responsibility and coordination.

MISCELLANEOUS

4.1 FACTORY TESTING

A. Before shipment of the equipment, the engine-generator set shall be tested under rated 0.8 PF load for performance and proper functioning of control and interfacing circuits. A factory test report shall be made available upon request. Tests shall include:
   1. Verifying all safety shutdowns are functioning properly.
   2. Both no-load and full-load steady state voltage checks shall be tested and measured line to line and speed (frequency) checks. Line-to-line current at rated voltage shall also be tested and measured.

4.2 OWNER'S MANUALS

A. **Three (3) sets** of Owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

4.3 INSTALLATION

A. The Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Engineer.

B. The Contractor shall furnish to the Owner a manufacturer tank chart with inches-to-gallon conversions. The Contractor shall mount a laminated copy of the chart inside the generator module for use by the delivery operator.

4.4 SERVICE

A. Supplier of the electric plant and associated items shall have permanent service and parts facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24-hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the Owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

4.5 WARRANTY

A. The standby electric generating system components, complete engine-generator set and automatic transfer switch shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five years. Such defective parts shall be repaired or replaced at the manufacturer's option. In addition, all labor for the replacement of these parts

for the engine-generator set and transfer switch will be covered for the first two years. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable and must be covered by the engine manufacturer. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate parts, service and warranty support.

4.6 CHECKOUT AND STARTUP

A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to check out the completed installation and to perform an initial startup inspection to include:
   1. Ensuring the engine starts (both hot and cold) within the specified time.
   2. Verification of engine parameters within specification.
   3. Set no load frequency and voltage.
   4. Test all automatic shutdowns of the engine-generator.
   5. Perform a full load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load supplemented with load banks. Test shall be per NFPA 110-2002 Paragraph 5-13.2.5.

4.7 SUBMITTALS

A. Provide complete sets of Engineering Submittals for approval prior to production release, showing all components, in addition to the engine, generator and automatic transfer switch. Submittals shall include complete system interconnection wiring diagrams and manufacturer's warranty form indicating compliance with these specifications.

4.8 SUBSTITUTIONS

A. The emergency power system has been designed to the specified manufacturer's electrical and physical characteristics, including the equipment sizing, spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components. Should any substitutions be made, the Contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs which may result from such substitutions. Alternate equipment suppliers shall furnish equipment submittals 14 days prior to bid date for approval to bid. As part of the submittals, the substitute manufacturer shall supply as a minimum engine, alternator, control panel and automatic transfer switch wiring diagrams and schematics. A separate list of all printed circuit boards with part numbers and current pricing must also be included.

END OF EMERGENCY STANDBY GENERATOR SYSTEM AND SWITCHING

SECTION 26 4313

SURGE PROTECTIVE DEVICES (SPD)

GENERAL

1.1 DESCRIPTION

A. These specifications describe the electrical and mechanical requirements for a hybrid high-energy power conditioning filter incorporating surge protective devices and high-frequency electrical line noise filtering. The specified unit shall provide effective high-energy surge protection, surge current diversion, high-frequency attenuation, and line control in ANSI/IEEE C62.41.1-2002 environments connected on the load side of the facility's meter or main overcurrent device. The unit shall be connected in parallel with the facility's wiring system.

1.2 QUALITY ASSURANCE

A. The requirements of the following standards shall become a part of this Specification by reference:
   1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41.1-2002, C62.41.2-2002, and C62.45-2002)
   2. Canadian Standards Association (CSA)
   3. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   4. National Electrical Manufacturers Association (NEMA)
   5. National Fire Protection Association (NFPA 70 (NEC), 75 and 78)
   6. Underwriters Laboratories Inc. (UL 1449 3rd Edition and 1283)
      The unit shall be UL and cUL 1449 3rd Edition Listed as a Surge Protective Device.

B. Acceptable Manufacturers
   1. Current Technology
   2. Thor Systems

C. Testing: The unit shall be thoroughly factory-tested before shipment. Testing of each unit shall include but shall not be limited to quality assurance checks, MCOV and clamping voltage verification tests.

D. Warranty: The manufacturer shall provide a full 15-year warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

E. Submittal Documentation: Documentation of unit's UL 1449 3rd Edition Voltage Protective Rating (VPR) shall be included as required product data submittal information. Manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41.1-2002, C62.41.2-2002, and C62.45-2002 Guidelines. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the specified unit. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.

PRODUCTS

2.1 GENERAL MATERIALS REQUIREMENT

A. The unit shall provide all modes of protection: line to neutral, line to ground, and neutral to ground.

B. High Frequency Tracking Filter: The unit shall include a UL1283 high-frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error producing transients and electrical line noise to harmless levels, thus eliminating disturbances which may lead to system upset.

C. Unit Status Indicators: The unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the status of MOV fusing.

D. Transient Counter: Front cover mounted transient counter (LCD or LED) shall totalize surges for all modes.

E. Nominal discharge current rating shall be I_n 20 kA.

F. Minimum SPD fault current ratings shall be 100Kaic.

APPLICATIONS

3.1 SERVICE ENTRANCE/MAIN DISTRIBUTION APPLICATIONS

A. The following table will indicate appropriate model numbers based on the electrical system ampacity. Surge current ratings are based on the Site Shield Risk Assessment Spreadsheet (TSI 067 3gSSH/r3).

B. SPDs connected to service equipment shall be listed as a type 1 SPD per UL1449 3rd Edition and shall have integral disconnect switch, and shall be connected to bus on the load side of the main switch.

SERVICE ENTRANCE/MAIN DISTRIBUTION APPLICATIONS			
Manufacturers' Models	**Electrical System Ampacity @ SPD Install Point**	**Surge Protection (kA)**	
Thor Systems		**Per Mode**	**Per Phase**
TSrc 300	4000 – 6000A	300	600
TSrc 250	2000 – 3000A	250	500
TSrc 200	1200 – 1600A	200	400
TSrc 150	600 – 1000A	150	300
TSrc 100	125 – 400A	100	200

3.2 PANELBOARDS AND BRANCH PANEL APPLICATIONS

A. As indicated on the Drawings, provide a panelboard with externally mounted SPD with high-frequency filtering per requirements listed in this specification. Provide number of breakers, voltage/phases as indicated on the Drawings. SPD shall physically connect to the top or bottom of panelboard allowing for SPD to be repaired or replaced without opening the dead front of the panelboard.

B. SPDs connected to Panelboards or Branch Panels shall be listed as a type 1 or type 2 SPD per UL1449 3rd Edition and shall be circuit breaker connected.

C. The following table indicates appropriate model numbers based on the electrical system ampacity. Surge current ratings are based on Site Shield Risk Assessment Spreadsheet (attached #TSI 067 3gSSH/r3). SPDs connected to Panelboards and Branch Panels shall be listed as a type 1 or type 2 SPD per UL 1449 3rd Edition and shall be 30 Amp circuit breaker connected.

PANELBOARDS AND BRANCH PANEL APPLICATIONS			
Manufacturer/Model Nos.	**Electrical System Ampacity @ SPD Install Point**	**Surge Protection (kA)**	
Thor Systems		**Per Mode**	**Per Phase**
TSnc 150	600A	150	300
TSnc 100	125 – 400A	100	200
TSnc 050	100A	50	100

EXECUTION

4.1 INSTALLATION

A. Install wiring connection to distribution system as indicated on the Drawings. Wiring length should be kept to an absolute minimum (3' or less) and be as straight as possible.

B. Wire sizes to Service Entrance/Main Distribution SPD should be 4#6, 1#6 G - 1" conduit.

C. Wire sizes to Panelboard and Branch Panel SPD should be as indicated 4#10, 1#10G – ¾" conduit.

END OF SURGE PROTECTIVE DEVICES (SPD)

SECTION 26 5100

LIGHTING

GENERAL

1.1 DESCRIPTION

A. This section specifies the lighting system requirements.

B. All fixtures shall be current source, provided with lamps ready to use.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Refer to another division for the ceiling systems.

B. Lighting system shall be coordinated with the ceilings.

1.3 SUBSTITUTIONS/VALUE ENGINEERING/PRICING

A. Substitution/value engineering requests shall be accompanied by complete manufacturers data with model numbers, cut sheets with options indicated, and a full photometric report. For exterior lighting, a computer generated point by point calculation shall be provided.

B. All substitution requests shall be submitted in completion to Engineer at least 10 days prior to bid date.

C. Pricing for lighting fixtures shall be separate from pricing for lighting controls (occupancy sensors, relay controls, dimming).

PRODUCTS

2.1 BALLASTS/DRIVERS

A. All fluorescent lamp ballasts shall be low-loss, high power factor Class “P,” with “A” sound rating and shall bear UL and CBM certifications. Ballast case temperature shall not exceed 90 degrees C.

B. All fluorescent fixtures shall be equipped with program-start ballasts. Multi-lamp ballasts shall be parallel-wired.

C. Linear and compact fluorescent lamp ballasts shall be electronic by Advance, General Electric, Osram Sylvania, or Universal.

D. All HID lighting fixtures shall have a high power factor, regulated output ballast provided by the fixture manufacturer, pre-wired with a glass tube fuse holder and fuse on each primary hot lead.

E. All LED drivers shall be constant current type with 0-10V dimming capability and proper heat dissipation.

F. Voltage shall be as defined on the drawings. Universal voltage shall be provided when available.

G. LED drivers shall have a 5-year minimum warranty.

2.2 LAMPS

A. LED lamps shall be long-life LEDs rated at 50,000 hours. Color shall be 3000K 0r 3500K with a maximum 2.5 step MacAdam (2.5 SDCM) color variation.

B. LED lamps shall have a 5-year minimum warranty.

C. Fluorescent lamps shall be energy saving type, 3,500 degrees K, CRI 75, of size and wattage as scheduled on the Drawings, unless noted otherwise on Light Fixture Schedule. They shall be General Electric or equal as manufactured by Sylvania or Philips unless indicated otherwise on Drawings. Lamps shall have a rated life of 20,000 hours minimum at three (3) hours per start.

2.3 LIGHTING FIXTURES

A. Letter designations beside outlet symbols on Drawings correspond to letter designations in Lighting Fixture Schedule.

B. Recessed fixtures, where used in an insulated ceiling, shall be equipped with thermal protection and shall bear the UL label indicating the suitability for such use.

C. Lens material for recessed fluorescent fixtures shall be 100% virgin acrylic, 0.125" thick in a square prism pattern similar to KSH-K-12 or as scheduled in Lighting Fixture Schedule.

D. Site lighting poles shall meet or exceed the local wind loading requirements of authority having jurisdiction.

E. Concrete pole bases shall be required for site lighting poles.

F. All linear fluorescent lighting fixtures (with double-ended lamps) shall have a factory-installed, concealed disconnecting means for each ballast.

EXECUTION

3.1 LIGHTING FIXTURES

A. Provide lighting fixtures at all locations indicated by distinctive symbols or notes on the Drawings.

B. Lighting fixtures shall be secured to ceiling grid with clips or screws and two #12 steel wires mounted to opposite corners of light fixture secured to structure.

C. Locations of lighting fixtures on the electrical drawings are approximate. Refer to Architectural reflected ceiling plan for actual locations of fixtures and mounting heights.

D. Lighting fixtures installed in plaster and stucco ceiling shall have plaster frame and shall be of the flanged type.

E. Fixtures recessed in concealed-spline tile and in gypsum board ceilings shall be flanged.

F. Surface or recessed fixtures in or on plastered ceilings shall be supported from pieces of support channel spanning across the main supporting channels and shall not depend on the metal lath for support.

G. Each recessed lighting fixture shall have a trim to match the type of ceiling (exposed grid, metal panel, etc.) in which it is being installed, except where noted otherwise on the plans.

H. Each lighting fixture recessed in a concrete wall shall have a junction box or wiring compartment provided inside the fixture housing. Provide conduit access into the fixture concealed.

END OF LIGHTING

SECTION 28 3111

INTELLIGENT, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
1. Fire alarm control panels
2. Automatic smoke and heat detectors
3. Fire alarm occupant notification devices
4. Auxiliary fire alarm equipment
5. System design, installation, testing, and certification

B. Work not covered by this Section:
1. Provision of sprinkler and fire pump switches to be monitored by the system, including (but not limited to): waterflow switches, tamper switches, fire pump supervisory switches, etc. These switches to be provided by the fire sprinkler contractor.
2. All wiring associated with the telephone line connections to the Digital Alarm Communicator Transmitter (DACT).
3. Provision of monitoring services by a UL-listed Central Station.

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 21 1317 Preaction Fire Sprinkler Systems

C. Section 21 3116 Diesel Driven Centrifugal Fire Pump

D. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

E. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) Listed and/or Factory Mutual (FM) Approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the electrical and/or fire alarm system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner’s minimum design and construction requirements relative to the fire protection systems described herein. The

Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications, to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of Georgia
   1. 2006 International Building Code with Georgia Amendments
   2. 2006 International Fire Code with Georgia Amendments
   3. Rules and Regulations of the Safety Fire Commissioner Chapter 120-3-3 Rules and Regulations for the State Minimum Fire Safety Standards (Effective 03/09/2010)

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2010) - Installation of Sprinkler Systems
   2. NFPA 20 (2003) - Installation of Stationary Fire Pumps
   3. NFPA 24 (2002) - Private Fire Service Mains and Their Appurtenances
   4. NFPA 70 (2005) - National Electrical Code
   5. NFPA 72 (2002) - National Fire Alarm Code
   6. NFPA 90A (2002) – Installation of Air Conditioning and Ventilation Systems
   7. NFPA 101 (2000) – Life Safety Code
   8. NFPA 1963 (2003) - Fire Hose Connections

C. The advisory provisions (Appendices/ Annexes) of the above referenced NFPA publications shall be considered to be mandatory, as though the word “shall” had been substituted for “should” wherever it appears.

D. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

E. Comply with all other applicable federal, state and local codes and ordinances.

F. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirements shall apply, as determined by the Engineer.

1.7 SYSTEM DESCRIPTION

A. General Requirements
   1. This specification contains performance, design, installation, testing, and servicing requirements for a new fire alarm signaling system, which is to be installed within this facility.

2. The scope of work includes implementation of the design of the system in accordance with this specification and applicable codes; preparation of appropriate drawings and calculations; submittal of drawings, calculations, equipment data sheets, and bill of materials; installation of the system in accordance with this specification, approved shop submittal, and applicable codes; and completion of final operational tests.
3. Installation shall include the fire alarm control panel (FACP), notification appliance circuit auxiliary power supplies, remote annunciator panels, initiating devices, notification appliances, monitor modules, control modules, supplemental relays, low voltage and high voltage wiring and raceways, surge suppressors, digital alarm communicator transmitter (DACT) and a preaction Releasing Control Panel (RCP).
4. The scope of work includes all necessary programming of the FACP, DACT, and RCP by the Contractor. All revisions to these programs which are required by the approval authorities, up to the point of final acceptance of the complete system by all approval authorities are to be carried out by the Contractor at no additional expense to the Owner.
5. The scope of work also includes provision of all necessary technical support personnel by the Contractor for completion of interim system inspections and tests as well as thorough acceptance tests by the various approval authorities.
6. The Contractor is responsible for coordination of the installation of all system related equipment with other subtrades. Where conflicts exist, the Contractor is responsible for making the General Contractor aware of each situation so that the appropriate action may be determined.
7. The Contractor is responsible for identifying all permitting requirements and jurisdiction specific requirements related to the system installation and shall assure that all local requirements have been met with respect to required equipment, specific system functional requirements, etc.

B. Performance Requirements
1. The fire alarm system shall respond to various system inputs as indicated on the Fire Alarm Sequence of Operations Matrix on the fire protection drawings.
2. All ALARM signals shall latch and shall not release until the system is manually reset at the FACP or an annunciator panel. All other signals (SUPERVISORY or TROUBLE) shall be self-restoring upon correction of the off-normal condition unless otherwise indicated on the Fire Alarm Sequence of Operations Matrix.

C. Design Requirements
1. The new system shall be a fully field programmable, microprocessor-based addressable system capable of two-way communication over signaling line circuits between intelligent/analog addressable initiating devices or addressable interfacing/control modules and the fire alarm control panel.
2. All equipment shall be new and unused with a warranty of at least one year from the date of final inspection and acceptance by the approval authorities.
3. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. All components of the system shall be UL-listed and/or FM-approved, and compatibility of all system components shall be verified.
4. The fire alarm control panel (FACP) and digital alarm communicator transmitter (DACT) shall be provided to monitor all initiating devices, including waterflow and valve tamper switches for all fire sprinkler systems, fire pump related valve tamper switches, fire pump supervisory signals, manual pull stations, spot and duct smoke detectors, and all other initiating devices indicated on the fire protection drawings and specifications.
5. The system shall provide a distinct evacuation signal using strobes and horn/ strobes. The system shall be arranged such that the evacuation signals are activated according to the Fire Alarm Sequence of Operations Matrix indicated

on the drawings. All system strobes shall continue to operate normally following silencing of the system until the system is reset. All strobes shall be synchronized to operate simultaneously.

6. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. The substitution of EEPROMS or other electronic memory chips shall not be required for any programming changes related to system modification or expansion. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. The Owner/ Tenant shall be provided with both a written and an electronic copy of the complete program for the system, along with appropriate software which will allow the maintenance staff to carry out programming changes involving the system.
7. The ability for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations is to also be incorporated in the resident software programming of the system.
8. An intelligent/addressable preaction Releasing Control Panel (RCP) shall be provided to monitor the preaction system initiating devices, including waterflow and valve tamper switches for the Data Center preaction fire sprinkler system, and spot-type photoelectric smoke detectors.
9. The FACP and DACT shall be located in the fire pump room, as indicated on the fire protection drawings.
10. The RCP shall be located in the Data Center.
11. Full-function remote annunciator panels—with: LCD display and the capability to acknowledge, silence, and reset all alarm, supervisory, or trouble conditions shall be provided and located near the Main Security Desk, as indicated on the fire protection drawings. Coordinate the exact location of the equipment with the tenant.
12. Selection of cable types and wire with respect to conductor size, shielding requirements, and separation between circuits shall be in full compliance with the requirements of the manufacturer of the FACP and the DACT, without exception. All circuit wire/cable shall be specifically listed for use with fire alarm systems.
13. To accommodate and facilitate job site changes, all circuits shall be individually configurable on-site.
14. The FACP shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
15. All subpanels, such as NAC Panels, shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
16. The FACP shall monitor the building fire pump and associated components/ conditions, as indicated on the fire protection drawings.
17. The FACP shall monitor the preaction RCP conditions, as indicated on the fire protection drawings.
18. All alarm and supervisory devices shall be monitored as separate and distinct alarm points using separate monitor modules as needed.
19. All initiating device circuits shall be arranged as Class B, Style D.
20. All notification appliance circuits shall be arranged as Class B, Style Y.
21. All signaling line circuits shall be arranged as Class B, Style 6.

D. Power Supply Arrangement

Power to the FACP, DACT, RCP, and NAC panels shall be supplied from individual, dedicated AC power circuits (one circuit per control panel), which serve no other loads.

Each circuit shall be equipped with a separate breaker, which is properly sized and identified per NFPA 70 and NFPA 72. Each circuit breaker shall be red marked and mechanically locked to prevent unauthorized operation.

E. Lightning/Surge Protection

Each AC power circuit shall be provided with a separate transient voltage surge suppression (TVSS) device. All low voltage power conductors associated with the fire alarm system passing from the interior to the exterior of a structure shall be protected with listed fast-acting TVSS devices, including, but not limited to, AC power supplies, initiating device circuits, signaling line circuits, notification appliance circuits, annunciator data circuits, and telephone lines.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Submittal Package

1. The Contractor shall prepare a SHOP SUBMITTAL PACKAGE covering the complete system. The SHOP SUBMITTAL PACKAGE shall be submitted to the approval authorities for review and approval. The submittal to the Engineer shall be in an electronic (PDF) format. The SHOP SUBMITTAL PACKAGE shall be approved prior to ordering materials or starting construction. The complete submittal shall conform to all requirements of this section.
2. At the time of completion of the submittal package and prior to transmittal to the approving authorities, the Contractor shall independently perform a quality assurance review of the entire submittal package internally to assure completeness and conformance with the specifications and design drawings. The Contractor shall use the submittal checklist in Appendix “A” of this section to accomplish this review. The completed checklist shall be submitted with the SHOP SUBMITTAL PACKAGE.
3. The SHOP SUBMITTAL PACKAGE shall include the following information:
   a. Complete system shop drawings using AutoCAD (2008 or newer), drawn to scale and showing all system components and functions, including FACP, DACT, RCP, initiating devices, addressable modules, relay modules, surge suppressors, interlocks, etc. Drawings shall also indicate point-to-point wiring to all devices and panels and an elementary wiring schematic (riser diagram) depicting the actual intended circuit paths and all devices on the system. Drawings shall indicate board level wiring diagrams indicating proper connections inside each panel and subpanel. Drawings shall indicate individual addresses of each addressable point at each device. Drawings shall indicate a listing of the proposed point descriptions (each point) for approval. The drawings shall indicate all wiring, raceway, and electrical box installation requirements from paragraph 3.2 as drawing notes for the installers. The drawing scale shall not be less than 1/8 in. = 1 ft.
      1) Drawings shall indicate wire counts, type and size of wire or cable used, and the size and type of all conduit and their locations throughout. The location of all junction boxes shall be shown. Comply with Appendix “C” for tables indicating cross-sectional area of all wire and cable to be used in the planned combination vs. conduit size, including cross-sectional area.
      2) All drawing submittals shall be submitted on the same size sheets. The drawings shall be sequentially numbered throughout the entire set.

b. Complete battery backup calculations and voltage drop calculations. Battery back-up calculations shall be performed in conformance with NFPA 72 for the FACP, DACT, and RCP. Ampere-hour requirements for each system component shall be submitted with the calculations. Voltage drop calculations shall utilize a starting voltage of 20.4 VDC.
c. Complete equipment data for all materials and equipment proposed for installation.
d. Installation, operation, and programming manuals for all panels and equipment.
e. Complete bill of materials, listing all system components by manufacturer, quantity, and part number, shall accompany the equipment submittal.
f. Complete details of manufacturers' warranties on equipment and Contractor's warranties on installation.
g. Complete manual(s) covering installation, operation, testing, and programming of the FACP and DACT.

B. Submittals to the Authorities Having Jurisdiction

Submit shop drawings, product data, and calculations directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities' field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

C. Record Documentation
1. Prepare and maintain on-site throughout the installation of the fire alarm system at least one set of marked-up ("red-lined") drawings which show the system as installed, including deviations from both the project drawings and the approved shop drawings. At least one set of marked-up drawings shall be provided to the Engineer at the time of, or prior to, the final acceptance test and installation review.
2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on electronic media (CD or DVD) in PDF and AutoCAD formats.
3. Record documentation shall consist of the following:
a. Record wiring and conduit/wire layout diagrams which indicate wire type, color-code, size, and device interconnection. These drawings shall be drawn to scale and not less than 1/8 in. = 1 ft and shall be produced and submitted in AutoCAD (2008 or newer) format.
b. Record elementary (including board level) wiring diagrams of the FACP, DACT, RCP, modules, and circuit interconnections.
c. Record riser diagrams that indicate the actual installed arrangement of all initiating, notification, and signaling circuits and auxiliary devices.
d. Record device location drawings with device numbers provided for all initiating, notification and control devices. Final selected power tap settings on all notification devices shall be indicated. The location of all junction boxes shall be shown.
e. Original technical literature produced by the manufacturer on all major parts of the system including control panel, DACT, modules, initiating and notification devices, power supplies, switches, and auxiliary controls.
f. Complete battery backup power calculations, performed in conformance with NFPA 72 for the FACP, fire alarm control units, and automatic

transmitters, and final voltage drop calculations for all notification device circuits.

g. Complete Bill of Materials for the system listing all system components, manufacturer, quantity, and part number.

h. Complete documentation of the manufacturer's warranties on both equipment and installation.

i. Complete printout of the FACP programming.

4. All record documents and related system documentation shall be submitted to the Engineer for review and approval prior to final submittal to the Owner.

D. Contractor's Record of Inspection and Testing

Upon completion of required inspection and testing, submit completed and signed Fire Alarm and Emergency Communication System Inspection and Testing Form, in accordance with NFPA 72 requirements, certifying systems meet or exceed the specified requirements.

1.9 QUALITY ASSURANCE

A. Qualifications

1. The fire alarm equipment distributor and installer shall be competent firms which are regularly engaged in the design, installation, testing, and servicing of fire alarm systems for commercial buildings.
2. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of sprinkler systems. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
3. Contractor shall utilize the services of a fire alarm equipment distributor (when applicable) which is a factory authorized representative and a stocking distributor of the equipment manufacturer and shall maintain a constant inventory of the parts typical of those used in the system installation covered under this specification. This distributor shall be located within 125 miles of the project site.
4. The fire alarm equipment distributor and installer shall each have a minimum of three (3) years of continuous experience in the design and/or installation of fire alarm systems and shall have completed a minimum of 5 projects of similar scope. It is intended that these projects incorporated similar equipment as proposed for this project.
5. Contractor shall have successfully installed fire alarm systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include the names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The Contractor shall be certified by the State as a fire alarm installer and shall provide a copy of certification.
6. All materials shall be new and in good condition, free of defects, scratches, corrosion, and contamination. Used equipment shall not be allowed.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-listed and/or FM-approved. The following UL standards and subcategories are applicable:

1. UL 268 Smoke Detectors for Fire Protective Signaling Systems (UROX), (URRQ).
2. UL 268A Smoke Detectors for Duct Applications (UROX), (URRQ).
3. UL 38 Manually Actuated Signaling Boxes for Use with Protection Signaling Systems (UNIU).
4. UL 464 Audible Signal Appliances (ULSZ), (UUMW).

5. UL 521 Heat Detectors for Fire Protective Signaling Systems (UQGS).
6. UL 864 Control Units for Fire Protective Signaling Systems – Ninth Edition (UOJZ), (UOQY), (UOXX).
7. UL 1971 Signaling Devices for the Hearing Impaired.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 70 and NFPA 72, to other applicable NFPA standards, to all Local, State and Federal codes, and to all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, manufacturers' product data, and battery and voltage drop calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal's office.
3. Approval of shop drawings, manufacturers' product data, battery and voltage drop calculations, and other materials submitted by the Contractor shall not relieve the Contractor's responsibility for full compliance with the design drawings and specifications unless written approval is requested by the Contractor and obtained from the Engineer for the non-complying feature.
4. Deviations from the contract documents and the Contractor's approved submittal documents will not be permitted without written consent from the Engineer.
5. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 72, local, state, or federal requirements, and the requirements of the Authorities Having Jurisdiction.
6. All work shall be performed in a high quality, professional, highly skilled, and timely manner.

1.10 SEQUENCING

A. All work performed shall be carried out in accordance with the applicable sections under Division 1 – General Requirements and shall adhere to the established completion schedule. Every effort shall be made to coordinate the installation of the fire alarm system with all other trades.

1.11 WARRANTY AND SERVICE AGREEMENT

A. The prime Contractor shall provide, as a part of the installation cost of this fire alarm system, a warranty and service agreement to cover the installation of the complete system as well as planned and emergency service for a period of one year following final system acceptance by the Owner and Engineer.

B. The warranty and service agreement shall include the following:
1. Labor, parts, and equipment for components placed under warranty.
2. Labor, parts, and equipment to accomplish any manufacturer recommended upgrades or component replacements.
3. Guarantee that all factory issued notifications related to system equipment/ programming upgrades and replacements will be carried out within 14 days of initial notification by the manufacturer.
4. During the warranty period, the fire alarm equipment distributor shall periodically perform complete inspections of the system including recommended tests and maintenance in accordance with the manufacturer's instructions and all applicable NFPA codes and standards.

5. This testing shall include all manual pull stations, detection devices, annunciators, control equipment, auxiliary equipment, notification circuits, and individual notification devices.
6. The fire alarm equipment distributor shall provide a written record of all sensitivity settings of system smoke detectors on a six-month frequency. The distributor is responsible for monitoring the drift or cleanliness level of the detectors based on sensitivity measurements and for taking appropriate action to prevent false alarms from occurring.
7. Complete written reports covering the test interval shall be submitted to the Owner/ Tenant within five working days of completion of field testing. These reports shall comply with the requirements of NFPA 72.
8. Written information concerning contacting of the fire alarm equipment distributor for normal and emergency service on a 24-hour period with appropriate phone numbers and contacts' names.
9. The Contractor shall guarantee provision of emergency service coverage for the system by properly trained, experienced, and knowledgeable service technicians 24 hours per day, 7 days per week, including all holidays.
10. Written guarantee of maximum call-back time of 1-hour, 4-hour on-site response time for emergency service related to alarm conditions and 12-hour on-site response time related to trouble and supervisory conditions form the initial call.
11. Provision for two (2) major programming changes and ten (10) minor programming changes at the option of the Owner/ Tenant during the warranty period at different times selected by the Owner/ Tenant. Major programming changes involve address changes, message changes, function changes, or other similar changes to fifteen (15) or more devices. Minor programming changes involve less than fifteen (15) devices.
12. Unit Price: The fire alarm contractor shall provide a unit price in accordance with the following:
    a. Within 30 days of the end of the warranty period, the fire alarm equipment distributor shall clean all devices, test and re-certify the fire alarm system, and provide a written report as stated elsewhere in this section. This testing shall include measurement/ verification of the sensitivity level of the system smoke detectors, with a complete sensitivity report included as part of the system testing documentation.
    b. This unit price is not part of the base bid.
    c. This unit price shall be initiated at the Owner's option.

1.12 EXTRA MATERIALS

A. Provide six (6) keys for each type of enclosure.

B. Provide one (1) of each type of automatic detector.

C. Provide one (1) of each type of monitor module, control module, and notification device installed.

D. Provide six (6) of each type of special tool required for system use and maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide a complete fire alarm system as indicated with all components manufactured by a single manufacturer to the extent possible. Acceptable manufacturers shall be Notifier, and GE Security/Edwards System Technology (EST), or approved equal. All equipment supplied under this specification shall be new, UL-listed and/or FM-approved for fire

protection, and have been verified to be compatible with the other components of the system.

2.2 FIRE ALARM CONTROL PANEL

A. The FACP shall be readily accessible and shall conform to the requirements of NFPA 72 for a local and Central Station protective signaling system. The complete assembly shall be UL-listed under the Ninth Edition of UL 864. The fire alarm panel enclosure shall be NEMA 2 rated and shall be equipped with a hinged cover and key-operated latch.

B. The FACP shall be approved for supervision of intelligent/addressable initiating devices through a microprocessor using digital protocol/ response protocol technology.

C. The FACP shall be fully field programmable using any compatible laptop computer. The FACP shall be capable of operating a minimum of one (1) printer, and three (3) remote liquid crystal display annunciators over standard RS-232-C interfaces. Level 1 programming changes shall be capable of being made by the Owner without the need for a laptop computer.

D. The FACP shall contain an alphanumeric system status display of at least 80 characters, which can be viewed without opening the FACP front cover. This display shall be field programmable and capable of automatically displaying device address number, device type, status of alarm or trouble and Owner designated message. It shall be possible to step through the current alarm or trouble indications through the use of a keypad on the control panel.

E. The FACP shall be capable of reading and recording the true sensitivity level of all intelligent/analog smoke detectors, including duct-type detectors. The control panel shall be specifically listed under UL 864 to perform this function from the panel. It shall not be necessary to perform any degree of testing at the individual detection devices in order to conform to the UL listing. The control panel shall also incorporate a walk-test feature to facilitate testing of the system and a minimum 800 event history buffer.

F. The FACP shall be capable of alarm verification on a per device basis. The main panel and all subpanels shall be modular in construction and designed to receive plug-in component boards to accomplish the various system functions described in this specification. The FACP shall have alarm and trouble silence switches with a subsequent alarm and trouble receiving feature. Silencing of audible notification signals shall not affect the operation of controlled relays or annunciators.

G. All AC power connections shall be hardwired on individual dedicated branch circuits, which serve no other loads. The circuit panels chosen for the dedicated branch circuits shall not include other circuits which supply motor related loads greater than 1 horsepower. The circuit and connections shall be mechanically protected within approved electrical enclosures, conduits or raceways. The power circuit disconnecting means shall be clearly labeled “Fire Alarm System Power – [location].” The disconnecting means shall be located in a locked enclosure, which is accessible only to authorized personnel.

H. Normal backup power to the FACP and the DACT shall be provided with 24 VDC battery back-up which is sized to operate the complete system on standby for 24 hours. Following this 24-hour period, the batteries shall be capable of operating the system under alarm conditions for a period of five (5) minutes.

I. The FACP and DACT shall be equipped with integral battery chargers which automatically keep the batteries fully charged. Wires, which lead from the backup battery terminals, shall be fully supervised for open and short circuit conditions.

J. The FACP and DACT shall automatically switch to back-up battery power in the event that the incoming power level drops to eighty (80) percent of rated voltage. All system functions including detection, supervision, annunciation, alarm retransmission, evacuation signaling and control functions shall operate identically on either primary or back-up power.

K. The FACP, auxiliary devices, and all electronic components shall be designed and installed such that no spurious signals or operations occur within the system, which are the result of radio/cellular phone transmissions. The system shall not be adversely affected by either a five (5) Watt hand-held two-way radio or a one half (1/2) Watt cellular telephone being operated within twelve (12) in. of any system panel or device.

L. The fire alarm control panels and any notification device circuit power supply panels shall each be separately protected by a separate UL-listed fast acting electrical transient surge suppressor which incorporates low Z earth grounding. The surge suppressor shall be UL 1449 listed with a 330-volt suppression level and shall have a maximum response time of 5 nanoseconds. The device shall meet IEEE CG2.41 Category B tests for surge capacity. The device shall feature multi-stage construction which includes inductors and silicon avalanche zener diodes. The devices shall be housed in a metal enclosure with a hinged, latching door, or a removable cover. Each enclosure shall be located immediately adjacent to the associated panel being supplied.

2.3 PREACTION RELEASING CONTROL PANEL

A. The intelligent/addressable preaction Releasing Control Panel (RCP) shall be readily accessible and shall conform to the requirements of NFPA 72 for a releasing control system. The complete assembly shall be UL-listed under UL 864, Ninth Edition. The panel enclosure shall be NEMA 2 rated and shall be equipped with a hinged cover and key-operated latch.

B. The RCP shall be approved for supervision of intelligent/analog initiating devices through a microprocessor.

C. The RCP shall be UL-listed for use as a releasing control panel.

D. The RCP shall be fully field programmable. Level 1 programming changes shall be capable of being made by the Owner without the need for a laptop computer.

E. The RCP shall contain an alphanumeric system status display of at least 80 characters, which can be viewed without opening the RCP front cover. It shall be possible to step through the current alarm, supervisory, and/or trouble indications through the use of a keypad on the control panel.

F. The RCP and all subpanels shall be modular in construction and designed to receive plug-in component boards to accomplish the various system functions described in this specification. The RCP shall have alarm, supervisory, and trouble silence switches with a subsequent alarm, supervisory, and trouble-receiving feature.

G. All AC power connections shall be hardwired on individual dedicated branch circuits, which serve no other loads. The circuit panels chosen for the dedicated branch circuits shall not include other circuits that supply motor related loads greater than 1 horsepower. The circuit and connections shall be mechanically protected within approved electrical enclosures, conduits, or raceways. The power circuit disconnecting means shall be clearly labeled “Fire Alarm System Power – [location].” The disconnecting means shall be located in a locked enclosure, which is accessible only to authorized personnel.

H. Normal backup power to the RCP shall be provided with 24 VDC battery back-up which is sized to operate the complete system on standby for twenty-four (24) hours. Following

this 24-hour period, the batteries shall be capable of system discharge and operating the system under alarm conditions for a period of five (5) minutes.

I. The RCP and the subpanels shall be equipped with integral battery chargers, which automatically keep the batteries fully charged. Wires, which lead from the backup battery terminals, shall be fully supervised for open and short circuit conditions.

J. The RCP and the subpanels shall automatically switch to back-up battery power in the event that the incoming power level drops to eighty (80) percent of rated voltage. All system functions shall operate identically on either primary or back-up power.

K. The RCP, the auxiliary devices, and all electronic components shall be designed and installed such that no spurious release shall occur as a result of electrical anomalies such as AC power loss, AC voltage transients, or electrostatic discharge.

L. The RCP, the auxiliary devices, and all electronic components shall be designed and installed such that no spurious signals or operations occur within the associated system, which are the result of radio/cellular phone transmissions. The system shall not be adversely affected by either a five (5) Watt hand-held two-way radio or a one-half (1/2) Watt cellular telephone being operated within twelve (12) inches of any system panel or device.

2.4 REMOTE ANNUNCIATOR PANEL

A. Remote annunciator panels shall include an 80-character LCD display to mimic the FACP display. The device shall be equipped with backlighting, and control switches for system acknowledge, signal silence, and system reset. The remote annunciator shall be capable of flush or surface mount.

B. The remote annunciator shall be equipped with a piezo sounder with alarm/trouble resound.

2.5 ADDRESSABLE MONITOR MODULES

A. Monitor modules shall be capable of monitoring normally open contact initiating device circuits and shall be equipped with LED status indicator light and high noise immunity.

2.6 ADDRESSABLE CONTROL MODULES

A. Control modules shall be capable of providing a single notification appliance circuit or Form-C relay contacts for air handler unit shutdown or other control functions, and shall be equipped with integral LED status light indicator and high noise immunity.

B. The individual control modules should be arranged such that they are controlled from the intelligent loop and remain activated until the fire alarm control panel has been reset.

C. The individual control modules shall be controllable based on programming of any number of initiating devices selected.

2.7 AUXILIARY DEVICES

A. The DACT shall be compatible with the FACP. The DACT may be an integral part of the FACP or may be a separate panel. If separate, it shall be enclosed within a separate metal enclosure equipped with a hinged lockable front, which is provided by the manufacturer for specific use with the DACT model provided. The DACT enclosure shall carry a NEMA 2 rating.

B. The DACT shall have the capability of transmitting all alarm, trouble, and supervisory signals, by address, to the alarm receiving station (i.e., each waterflow, each detector,

etc. shall be a separate signal received at the alarm receiving station). The DACT shall be arranged for dual phase line operation with built-in phase monitor and shall be capable of automatically generating a 24-hour test.

C. The AC power conductors supplying the FACP and DACT shall be protected by a separate UL-listed fast acting electrical transient surge suppressor, which incorporates low Z earth grounding. The device shall meet the requirements of UL 1449 and shall be housed in a separate metal latched enclosure. The enclosure shall carry a NEMA 3R rating. All penetrations into the NEMA enclosure shall be from the bottom.

D. All low voltage circuits leading from the fire alarm panel, including initiating and notification circuits, annunciator data circuits, as well as the telephone lines, shall be protected by a separate UL-listed fast-acting electrical transient surge suppressor, which incorporates low Z earth grounding. The device shall meet the requirements of UL 497B and shall be housed in a separate metal latched enclosure. The enclosure shall carry a NEMA 2 rating. All penetrations into the NEMA enclosure shall be from the bottom.

2.8 WIRING, RACEWAYS AND RELATED MATERIALS

A. All wire and cable of the system shall be listed and shall fully conform to the requirements of the National Electrical Code (NEC) as well as the requirements of the panel manufacturers.

B. All conduit, junction boxes, device boxes, terminal cabinets and related hardware and equipment shall be listed and shall fully conform to the requirements of the NEC. All conduit shall be selected such that the maximum fill capacities indicated in the NEC are not exceeded. All device boxes and junction boxes shall similarly be selected such that the fill capacities of these components are within the limits indicated in the NEC. Device mounting boxes must be selected based on proper consideration of the space taken up by the device within the box. Refer to Appendix “C” at the end of this specification.

2.9 SMOKE DETECTORS

A. Smoke detectors shall be photoelectric, analog, addressable spot-type devices. The detectors shall be a plug-in unit which mounts to a twist-lock base. The detector shall incorporate an LED to indicate both normal operation (pulsed light) and alarm activation (steady light).

B. The sensitivity of the individual detectors shall be readily determinable through the fire alarm control panel. The sensitivity setting of the individual detectors shall also be adjustable through the control panel.

C. The detectors shall fit into a base that is common with both photoelectric and thermal detectors and shall be compatible with other addressable detectors, addressable manual stations, and addressable interface/control modules on the same circuit.

D. There shall be no limit to the amount of sensors, stations or interface control modules, which may be activated, or in alarm simultaneously.

2.10 DUCT DETECTORS

A. Duct detectors shall be analog/ addressable, photoelectric, spot-type devices. The positioning of the duct detector shall be carefully chosen to assure optimum performance of the detector. The detector shall incorporate an LED to indicate both normal operation (pulsed light) and alarm activation (steady light).

B. Differential pressure measurements shall be taken and recorded by the Contractor to assure compliance with the manufacturer’s requirements. The detector shall incorporate

sample tubes which are both selected and installed in full conformance with the manufacturer's requirements.

C. The detector shall be the plug-in type with a twist-lock base. The sensitivity of the individual detectors shall be readily determinable through the fire alarm control panel. The sensitivity setting of the individual detectors shall also be adjustable through the control panel.

D. There shall be no limit to the amount of sensors, stations or interface control modules, which may be activated, or in alarm simultaneously.

2.11 MANUAL STATIONS

A. Manual stations shall be single action, addressable type. The manual station shall be installed as indicated on the fire protection drawings and listed to UL 38.

2.12 HORN/STROBE DEVICE

A. Horn/strobe device(s) shall be installed where indicated on the fire protection drawings. The devices shall be listed to UL 1971 and UL 464 and shall be weatherproof type suitable for mounting on an exterior wall.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment, and shall take any necessary measures to keep the premises clean at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Neither the Engineer nor Owner shall be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. This responsibility rests with the Contractor.

D. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA Codes and Standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean.

E. The Contractor shall install the system devices and equipment in accordance with approved shop drawings.

F. The Contractor is responsible for coordination of system requirements with all conditions of the building and site including, but not limited to, blind spaces, shelving, lights, grilles and diffusers, piping, duct work, doors, windows, equipment platforms, walls (fire-rated and non-fire-rated), beams, joists, columns, HVAC equipment, electrical panels and equipment, ceilings, areas without ceilings, wall construction, floors and all construction, equipment and building appurtenances.

G. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

H. The fire alarm contractor shall wire any duct detectors installed by the mechanical contractor.

I. The fire alarm contractor shall wire up to ATU or RTU shutdown control modules; mechanical/electrical contractor shall wire control modules to ATU or RTU control circuits.

J. The Contractor is responsible for achieving the required audibility as indicated on the drawings. The indicated horn/ strobe layout on the drawings is intended to indicate the minimum acceptable visible notification.

3.2 WIRING, RACEWAYS AND ELECTRICAL BOXES

A. All AC power or AC control wiring shall be run in EMT conduit in full compliance with NFPA 70. In no case shall AC power wiring be run in the same conduit as any other fire alarm circuits. A minimum separation distance of ½ inch between AC power or control wiring and all circuits shall be maintained within the FACP, DACT, and all other fire alarm interfaces. The exception to this would be at terminal blocks within panels or at the interface with devices. At these locations, maximum possible separation shall be achieved.

B. All wiring/cables shall be run in EMT conduit up to the elevation of the bottom member of the bar joist or roof structure member. The conduit shall be bent 90° at the top of all conduit risers so as to terminate horizontally at the bottom member. All wiring/cables shall be neatly routed and fastened in full conformance with the requirement of NFPA 70 and configured so that the structural members protect the wiring from mechanical damage. All wiring/cables which are not in conduit shall be supported by building structural members for the full running length of the wire or cable. “Stringing” cable across the bottom members of the structure will not be permitted.

C. The selection of cable types and wire with respect to conductor size, shielding requirements and separation between circuits shall be in full compliance with the requirements of the manufacturer of the fire alarm panels without exception. Voltage drop calculations shall be submitted for the notification circuits of the system. All initiating, signaling, and notification circuit wire/cable shall be specifically listed for use with fire alarm systems. In the event that performance testing indicates that conductor performance or separation is inadequate, the Contractor shall make all necessary corrections without expense to the Owner.

D. The selection of conductors shall fully comply with the National Electrical Code (NFPA 70), Articles 725 and 760. The stranding restrictions of individual conductors shall be complied with without exception. All wiring shall be specifically listed for fire alarm system application. Samples of all cable and wire to be utilized in the installation shall be submitted to the Engineer for approval prior to usage.

E. Permanent machine lettered wire markers with numbers/ letters shall be used to identify the terminations of all conductors within the FACP, RCP, and the DACT. Permanent wire markers shall also be used at all devices which have numbered terminals. Provide a schedule of numbers on the appropriate drawings.

F. In no case shall conductors be joined by splicing. Appropriate lugs and terminal blocks, or pressure connectors shall be used where conductors are joined. Wire nuts shall not be used. All terminal blocks shall be either the fully insulated, floating type, or be permanently mounted to appropriate metal enclosures using metal screws. Use of adhesive strips or similar means to mount terminal blocks is prohibited. All connections to the fire alarm control panels terminal blocks, as well as all connections to screw terminals of devices, shall be completed with properly sized and crimped lugs if stranded wire is utilized. In all cases where end of line resistors share a terminal block connection with another conductor, the leads of the resistor shall be within two AWG sizes of the other conductor without exception.

G. In all cases where shielded cable is used, the shielding shall be maintained continuously throughout the circuit and shall terminate to appropriate terminal screws within the FACP, RCP, DACT, and other applicable devices in full compliance with manufacturers' requirements and system listings.

H. All wires shall be checked for grounds, shorts, opens, and correct resistance, capacitance and other applicable parameters prior to termination of the circuits at the fire alarm control panel or subpanels and prior to the installation of devices. The minimum resistance to ground or between any two conductors shall be 10 megohms, verified with a voltage generating insulation tester. The Contractor shall provide written documentation and certification of this testing on a per circuit basis. The Contractor shall give a minimum of 2 weeks' notice to the Engineer in advance of all testing so that these tests may be witnessed at the discretion of the Engineer.

I. Where wiring and conduit penetrate fire-rated barriers, appropriate fire stopping shall be put in place. Installation of materials shall result in fire resistance rating equal to or greater than the rating of the penetrated assembly, unless otherwise indicated.

J. Wherever wiring and cabling pass through building walls, floors and roofs or is exterior to the building, it shall be enclosed in EMT or flexible conduit. Penetrations through exterior walls or roofs shall be sealed weather tight.

K. Four-inch square or double-gang electrical boxes which house addressable devices shall not be used as a junction box for other circuits.

L. All junction boxes shall be painted red externally. Junction box covers shall also be painted red on both sides. The Contractor shall protect building structural elements and interior finishes from being painted. All junction boxes for which the circuit use is not readily discernible shall be permanently labeled. All junction boxes which contain devices shall be labeled. All labels shall consist of engraved phenolic signs which have been approved by the Engineer prior to installation. The use of handwriting to perform this identification is not acceptable.

M. To prevent insulation damage or device damage, the following requirements apply:
   1. Any threaded EMT or flexible conduit terminating at metal boxes or cabinets shall be provided with insulating bushings at throat of connector.
   2. Any EMT connectors must be the all steel compressing type with insulated throats. The exception to this is indenture type which may be used on exposed unfinished areas to obtain a tighter fit to the surface.
   3. Provide a clamp or other approved restraining device where cables or wires which are not in conduit enter junction boxes.

N. All panel enclosures installed in gypsum wallboard walls shall be recess mounted interconnecting circuits and shall be concealed within the wall cavity or in the space above the suspended ceiling or other space to the maximum extent possible. All circuits shall be routed and secured in full compliance with NFPA 70.

O. All panel enclosures installed outside or in the fire pump room shall be arranged so that all penetrations into the enclosure shall be through the bottom of the enclosure. Coordinate location with construction drawings.

3.3 FIELD QUALITY CONTROL AND TESTING

A. The Contractor shall provide a qualified project superintendent for the overall management and supervision of the work.

B. The project superintendent shall assure that adequate supervision is provided during all periods of installation of the fire alarm system. The project superintendent and all job site

supervisors shall have a minimum of five years of continuous experience in the installation of fire alarm systems of similar scope and complexity.

C. All system smoke detectors and heat detectors shall be suitably protected against contamination up to the time of the final acceptance tests.

D. Upon completion of the installation, the Contractor shall fully functionally test all alarm initiating devices, supervisory devices, control devices and notification devices for proper response and effectiveness. A trouble condition shall be initiated at each system device to verify circuit supervision. Operation of all annunciating devices including the fire alarm panels shall be verified. Testing shall include thorough sound level measurements of audible notification devices with these tests being fully documented by means of marked-up drawings.

E. The system shall be subject to inspection and acceptance by the Authorities Having Jurisdiction and for the purpose of determining that the system is in accordance with federal, state, local, and specification requirements and applicable standards of the NFPA and other related codes.

F. Prior to the system acceptance testing, the Contractor shall provide, in writing, certification that the installed system is in full compliance with the design documents and all applicable codes and standards. See Appendix “B” for a sample letter.

G. The Contractor shall be responsible for performing, documenting, and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification. After completing his testing, the Contractor shall demonstrate full operational capability of the fire alarm system, as well as full compliance with all design documents, codes and standards, to the Engineer. The Engineer and Authorities Having Jurisdiction shall be notified two weeks in advance of this testing.

H. The Contractor shall perform supplemental tests and shall render additional services in connection with the fire alarm system, as directed, at no additional cost to the Owner. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

I. In the event the acceptance test of the system results in the need for system repair or modification, the Contractor shall demonstrate the operability of the system to the full satisfaction of the Owner and Engineer following the completion of repairs or modification and an additional 15-day burn-in period.

J. In the event that the Authorities Having Jurisdiction require a separate demonstration of the operability of the system for acceptance purposes, these additional tests shall be carried out by the Contractor without expense to the Owner.

K. The Contractor shall conduct an independent quality assurance review of all developed AutoCAD Version (2008 or newer) "record" drawings to assure accuracy and completeness of these drawings. These drawings, as well as the O&M manuals and all other system documentation, shall be turned over to the Owner/ Tenant prior to the start of the final acceptance tests.

3.4 TRAINING OF EMPLOYEES

A. An employee of the Contractor, the fire alarm equipment distributor, and/or a manufacturer’s representative shall provide instruction to key employees of the Owner/ Tenant on the operation and maintenance of the complete system. The Contractor shall contemplate a minimum of four (4) separate training sessions of one to two hours in length. Some of these training sessions may need to be conducted after normal working

hours in order to accommodate all working shifts. At least one of these training sessions shall be completed prior to the start of the first system 15-day burn-in period.

B. The training shall be arranged in two segments. The first segment shall include a detailed overview of the system operation for the benefit of the security staff. The second segment shall include a detailed review of system operation, control, troubleshooting, and periodic testing and maintenance. This training shall also include detailed instruction covering completion of programming changes for the system.

C. Six (6) bound copies which summarize the training instruction shall be submitted to the Owner/ Tenant for future reference.

D. A typical training session shall be videoed by the Contractor and three (3) copies of the video in DVD format turned over to the Owner/ Tenant for future training of employees.

~END OF SECTION~

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Appendix "A"

Submittal Checklist

SUBMITTAL CHECKLIST

P = PROVIDED
N/P = NOT PROVIDED
N/A = NOT APPLICABLE

ITEM	STATUS	INITIALS
A. Drawings		
1. Symbol Legend		
2. Initiating Device Locations Shown/Correct Symbols Used		
3. Initiating Device Addresses Shown		
4. Notification Device Locations Shown/Correct Symbols Used		
5. Notification Device Numbers Shown		
6. Circuit Point-to-Point Wiring to All Devices		
7. Complete Elementary Wiring Schematics		
8. Location of All Conduit Shown With Sizes Indicated		
9. Table Showing:		
a. Wire Counts		
b. Type		
10. Table of Conduit Fill Calculation Results		
11. Location of All Junction Boxes and Pull Boxes		
12. Table Indicating Color-Coding of Wires		
13. All Relays, Modules, Auxiliary Devices Shown/Correct Symbols Used		
14. All Drawings Same Size		
15. All Drawings Sequentially Numbered		
B. Complete Battery Calculations For Each Panel		

ITEM	STATUS	INITIALS
C. Current Manufacturer's Data Sheet Identifying Component By Part Number, Type, Etc.		
1. Boards		
2. Modules		
3. Amplifiers		
4. Power Supplies		
5. Batteries		
6. Transponder Control Modules		
7. Annunciator Control Modules		
8. Remote Display Annunciator		
9. Duct Detector, Detector Housing, Tubes		
10. All Enclosures		
11. All Other System Devices or Components		
12. Print-out of Program		
13. Installation Manual for FACP		
14. Installation Manual for Power Supply		
15. FACP Programming Instructions With Password Protection Levels		
16. Bill of Materials		
17. Manufacturers' Warranties		
18. Installers' Warranties		
19. Contractor Q.A. Certification		
20. Installation Instructions Which Are Included With Packaged Devices		
D. Wire Samples		

Appendix "B"

Letter of Certification

LETTER OF CERTIFICATION

Building 1
The Industrial Park

To Whom It May Concern:

I certify that XYZ Company has installed, inspected, and tested the fire alarm system in full compliance with all design documents and all applicable codes and standards.

Sincerely,

Max Worker
Manager, Testing and Inspections

Appendix "C"

Tables

Tables

Table 1. Percent of Cross Section of Conduit and Tubing for Conductors

Number of Conductors	1	2	Over 2
All Conductor Types	53	31	40

Table 2. Dimensions and Percent Area of Conduit and Tubing (Areas of Conduit or Tubing for the Combinations of Wires Permitted in Table 1)

Electrical Metallic Tubing					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.622	0.304	0.094	0.122	0.161
3/4	0.824	0.533	0.165	0.213	0.283
1	1.049	0.864	0.268	0.346	0.458
1-1/4	1.380	1.496	0.464	0.598	0.793
1-1/2	1.610	2.036	0.631	0.814	1.079
2	2.067	3.356	1.040	1.342	1.778

Flexible Metal Conduit					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.635	0.317	0.098	0.127	0.168
3/4	0.824	0.533	0.165	0.213	0.282
1	1.020	0.817	0.253	0.327	0.433
1-1/4	1.275	1.277	0.396	0.511	0.677
1-1/2	1.538	1.857	0.576	0.743	0.984
2	2.040	3.269	1.013	1.307	1.732

Rigid Metal Conduit					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.632	0.314	0.097	0.125	0.166
3/4	0.836	0.549	0.170	0.220	0.291
1	1.063	0.888	0.275	0.355	0.470
1-1/4	1.394	1.526	0.473	0.610	0.809
1-1/2	1.624	2.071	0.642	0.829	1.098
2	2.083	3.408	1.056	1.363	1.806

SECTION 32 3113

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases; concrete foundation for posts and center drop for gates.

C. Manual gates and related hardware.

1.2 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.3 REFERENCE STANDARDS

A. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.

B. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric; 2011.

C. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride)(PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008.

D. CLFMI CLF 2445 - Product Manual; Chain Link Fence Manufacturers Institute; 1997.

1.4 SUBMITTALS

A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.

PART 2 PRODUCTS

2.1 MATERIALS

A. Posts, Rails, and Frames: ASTM F 1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 25 ksi.

B. Wire Fabric: ASTM F668 polymer-coated steel chain link fabric where indicated on drawings.

C. Barbed Wire: PVC-coated steel, complying with ASTM F1665; 2 strands of 0.086 inch diameter wire, with 4-pointed barbs at 5 inches on center where indicated on drawings.

D. Concrete: Type specified in Section 03 3000.

2.2 COMPONENTS

A. Line Posts: 2.38 inch diameter.

B. Corner and Terminal Posts: 2.88 inch.

C. Swing Gate Posts for gate leaf widths:
   1. Up to and including 6 feet: 2.88 inch.
   2. Over 6 to 12 feet: 4.5 inch.
   3. Over 12 to 18 feet: 6.63 inch.
   4. Over 18 to 24 feet: 8.63 inch.

D. Swing Gate Frame for gate leaf widths:
   1. Up to 8 feet: 1.9 inch.
   2. Over 8 feet: 2.38 inch.

E. Horizontal Slide Gate Posts for gate leaf widths:
   1. Opening Width up to 12 feet: 2.88 inch.
   2. Opening Width over 12 feet: 4.5 inch.

F. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.

G. Fabric: 2 inch diamond mesh interwoven wire, 9 gage thick, top selvage twisted tight, bottom selvage twisted tight.

H. Tension Wire: 6 gage thick steel, single strand.

I. Tension Band: 3/4" wide x .074 inch (14 gage) thick steel.

J. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.

D. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

E. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.4 FINISHES

A. Components, Sliding Gate and Accessories: Where indicated on drawings polymer coating according to ASTM F 1043, 10-mil minimum PVC or 3-mil minimum polyester finish applied over coating of minimum 1.8 oz/sq ft galvanizing.

B. Fabric: Where indicated on drawings, polymer coating according to ASTM F 668, Class 2a, minimum .015 inch PVC coating extruded and adhered over .30 oz/sq ft galvanizing.

C. Polymer coating color shall be black.

D. Accessories: Same finish as fabric.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
   1. If not indicated on drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross-section of the post.

D. Line Post Footing Depth Below Finish Grade: ASTM F567.

E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.

H. Do not stretch fabric until concrete foundation has cured 28 days.

I. Stretch fabric between terminal posts or at intervals of 500 feet maximum, whichever is less.

J. Position bottom of fabric maximum 2 inches above finished grade.

K. Exterior locations: Provide top and bottom tension wire.

L. Interior locations: Provide top and bottom rail.

M. Fasten fabric to rail, line posts, braces, and tension wire with tie wire at maximum 15 inches on centers.

N. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

O. Install bottom tension wire stretched taut between terminal posts.

P. Install support arms sloped outward and attach barbed wire; tension and secure.

Q. Do not attach the hinged side of gate to building wall; provide gate posts.

R. Install gate with fabric to match fence. Install hardware.

S. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.2 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Components shall not infringe adjacent property lines.

END OF SECTION

SECTION 32 3120

ORNAMENTAL FENCING

PART 1 - GENERAL

1.1 WORK DESCRIBED IN THIS SECTION:

A. Exterior picket style tubular welded steel fence and accessories.

B. Excavation for post bases.

1.2 QUALITY ASSURANCE:

A. Manufacturer: Company specializing in commercial quality ornamental metal fencing with two years experience.

1.3 SUBMITTALS:

A. Submit product data under provisions of Section 01 3000.

B. Shop Drawings: Include typical details identifying all components. Provide details for motorized gates.

C. Submit manufacturer's installation instructions under provisions of Section 01 3000.

1.4 WARRANTY:

A. Manufacturer shall warrant the product for ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Ornamental metal fence system shall be equal to Ameristar “Montage Industrial”, classic style. Provide horizontal rails, with pointed picket tops and standard post tops. Pickets shall be spaced maximum of 4 inches apart.

2.2 MATERIALS:

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft2, Coating Designation G-60.

2.3 COMPONENTS:

A. Posts: Post spacing nominal 8 feet on center.
   1. Posts to 6 ft high: 2-1/2 inch square x 14 gauge minimum.

B. Rails: All rails shall be 1-3/4 inch square x .105 inch minimum.

C. Pickets: All pickets shall be 3/4 inch square x 16 gauge minimum.

D. Picket Spacing: Space pickets equally, providing maximum 4" air space between pickets.

2.4 FABRICATION:

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to

standard spacing using calibrated alignment tools. The aligned pickets and rails shall be joined at each picket-to-rail intersection by fusion welding process, completing the rigid panel assembly.

C. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

2.5 FINISHES:

A. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils.

B. The color shall be black.

2.6 GATES:

A. Gates shall be fabricated using fusion welded ornamental panel material and 1-3/4" sq. x 14ga. gate ends. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install fence and accessories in strict accordance with manufacturers recommendations and approved shop drawings. Line posts shall be spaced a maximum of 8 feet on centers.

B. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.

C. Posts shall be set in concrete footers having a minimum depth of 36" (Note: local restrictions of freezing weather conditions may require a greater depth). Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

D. Fence panels shall be attached to posts with brackets supplied by the manufacturer.

3.2 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts, adhere to the following steps to seal the exposed steel surfaces:
   1. Remove all metal shavings from cut area.
   2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
   3. Apply 2 coats of custom finish paint matching fence color.

3.3 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

B. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.

END OF SECTION

SECTION 329200

LAWNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Sodding.
2. Seeding

B. Related Sections include the following:
1. Division 32 Section "Landscape" for landscape installation.
2. Division 32 Section "Irrigation" for irrigation system installation.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.

C. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

D. Qualification Data: For landscape Installer.

E. Material Test Reports: For existing surface soil.

F. Planting Schedule: Indicating anticipated planting dates for each type of planting.

G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

1.7 SCHEDULING

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Lawns: until Date of Substantial Completion.

a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Maintain irrigation system to keep lawn uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
2. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow grass 1 to 2 inches (25 to 50 mm) high.

E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

PART 2 - PRODUCTS

2.1 TURFGRASS

A. Turfgrass Sod: Certified,complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Sod Species: Tifton 419 Bermuda

C. Turfgrass Seed: Common Bermuda

D. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 5 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
1. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or

mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land**,** bogs or marshes.

b. See plans for areas of turf where topsoil shall be provided and placed by others under a separate contract.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.
2. Provide lime in form of dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

H. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1/2-inch (12.5-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.6 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.7 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than [1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

3. Spread soil amendments to a depth of 4 inches (100 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    a. Reduce elevation of planting soil to allow for soil thickness of sod. (Add alternate).

C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least of 6 inches (150 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches (150 mm) of soil. Till soil to a homogeneous mixture of fine texture.

    a. Apply fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade,

eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.

C. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.6 SATISFACTORY LAWNS

A. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 329300

LANDSCAPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Trees.
2. Shrubs.
3. Ground cover.

B. Related Sections include the following:
1. Division 32 Section "Irrigation" for underground irrigation systems.
2. Division 32 Section “Lawns” for turf establishment.

1.3 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

F. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:

1. Manufacturer's certified analysis for standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Qualification Data: For landscape Installer.

D. Material Test Reports: For existing surface soil and imported topsoil.

E. Composition of planting soil mix.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

D. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials fourteen days in advance of delivery to site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.

B. Do not prune trees and shrubs before delivery, except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

C. Handle planting stock by root ball.

D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 COORDINATION

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 WARRANTY

A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for Trees, Shrubs and Groundcover: One year from date of Substantial Completion.
2. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
3. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.9 MAINTENANCE

A. Trees Shrubs and Groundcover: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

1. Maintenance Period: Up until date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANTS

A. Provide plants of species indicated, established and well rooted in containers or balled and burlapped, and complying with ANSI Z60.1.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 10 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
   1. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

      a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land**,** bogs or marshes.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

   1. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 90 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

H. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm)

sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Pinestraw

2.7 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.

B. Guy and Ties: Arbortie or approved equal per City of Jefferson requirements.

C. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.

D. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.8 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

2.9 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the following quantities:

1. 60% Topsoil as specified.
2. 40% prepared additives (by volume as follows):
   2 parts humus and/ or peat
   1 part shredded pine bark (bark pieces between ½ and 2 inches in length)
   1 part sterilized composted cow manure
3. Commercial fertilizer as recommended in soil report
4. Lime as recommended in soil report.

B. Pre-manufactured planting soil mixes may be used if similar in content to soil mixes shown above. See submittal requirements for required pre-approval.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 PLANTING BED ESTABLISHMENT

A. Loosen subgrade of entire planting beds to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil mix to a depth of 6 inches (150 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil mix.

B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.4 PLANTING

A. Set out and space plants as indicated.

B. Dig holes large enough to allow spreading of roots, and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.5 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.

1. Organic Mulch: Apply 3-inch (75-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.6 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent pavings and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.7 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 329300