DOCUMENT 00005

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Architectural

<p>| A-001    | Symbols &amp; Fixture Heights                        | ● ●                                            |
| A-100    | Architectural Reference Plan                     | ● ●                                            |
| A-200    | LAIR Reference Plan                              | ● ●                                            |
| A-201    | Elephant Holding Building Floor Plan             | ● ●                                            |
| A-202    | Elephant Holding Building Roof Plan, Drainage Plan and RCP | ● ● |
| A-210    | Elephant Holding Building Elevations and Sections | ● ● |
| A-211    | Elephant Holding Building Elevations             | ● ●                                            |
| A-212    | Elephant Holding Building Elevations and Sections | ● ● |
| A-213    | Elephant Holding Building Sections               | ● ●                                            |
| A-230    | Elephant Holding Building Wall Sections          | ● ●                                            |
| A-240    | Elephant Holding Building Details                | ● ●                                            |
| A-241    | Elephant Holding Building Details                | ● ●                                            |
| A-300    | Filtration Building Plans                         | ● ●                                            |</p>
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ADVERTISEMENT TO PRE-QUALIFY AND BID

Sealed proposals will be received by Hoar Program Management on behalf of The Birmingham Zoo at 2630 Cahaba Rd Birmingham, AL 35223 until 3:00 PM Central Time, Thursday, September 10 for:

THE BIRMINGHAM ZOO - TRAILS OF AFRICA

at which time and place they will be publicly opened and read in the auditorium of the Birmingham Zoo.

A. SCOPE OF WORK:
The general scope of the work includes but is not limited to: Building and site improvements for a 5 acre animal exhibit, including site modifications, construction of a 10,000 sf large animal support facility, a 1,500 sf café, a 1,500 sf restroom building, a life support and filtration system to support water features in the exhibit, and gunite rockwork features.

Multiple-Prime Bid Package will be as follows:
Package No. 1 - Site General Trades
Package No. 2 - Building General Trades
Package No. 3 - Life Support & Filtration
Package No. 4 - Electrical
Package No. 5 - Plumbing
Package No. 6 - H.V.A.C.
Package No. 7 - Combining Package 5 (Plumbing) and Package 6 (HVAC)
Package No. 8 - Rockwork
Package No. 9 - Landscape & Irrigation
Package No. 10 - Site Barriers and Hardscape

B. PRIME CONTRACTOR BIDDER PRE-QUALIFICATIONS: Prime Contractor Bidders interested in submitting a proposal must apply for pre-qualification for each Bid Package in which they have an interest in bidding. All applicants for registration must be licensed under the Provision of Title 34, Chapter 8, Code of Alabama, 1975. Only prime contractor bidders who have been pre-qualified by the Birmingham Zoo will be eligible to bid for a package. The pre-qualification procedure is intended to identify responsible and competent prime contractor bidders relative to the requirements of the Project and their Bid Package. Each applicant will be notified of the results of its pre-qualification. Applicants are encouraged to pre-qualify as early as possible. The Owner reserves the right to waive technical errors in applications or abandon the registration process, should the interests of the Owner appear to be promoted thereby.

Owner:
The Birmingham Zoo
Attn: Ms. Holly Vines
One Wild Place
Birmingham, AL 35223
Phone: 205-397-3843
Fax: 205-879-9426
Email: hjohnsey@birminghamzoo.com

Construction/Program Manager:
Hoar Program Management
Attn: John Fogg
Two Metroplex Drive, Suite 300
Birmingham, AL 35209
Phone: (205) 423-2326
Fax: (205) 423-2323
Email: jfogg@hoarpm.com
C. BIDS BY PRE-QUALIFIED PRIME CONTRACTOR BIDDERS

Documents: After written notice to pre-qualified bidders is given, pre-qualified prime contractor bidders may obtain bid documents from the Construction Manager (see address above). Bid documents will be provided in PDF format. Drawings and specifications may be examined by appointment at the office of the Construction Manager listed above, and at the following plan rooms: F.W. Dodge, B.C.I.A.

Bonds: A certified check or bid bond payable to The Birmingham Zoo, Inc. in an amount not less than five percent (5%) of the amount of the bid, but in no event more than $10,000.00, must accompany the bidder’s proposal. Performance and Statutory Labor and Material Payment Bonds will be required at the signing of the Contract.

Bids: Bids must be submitted on proposal forms or copies thereof furnished by the Architect. No bid may be withdrawn after the scheduled closing time for receipt of bids for a period of sixty (60) days. The Owner reserves the right to reject bids if such action is determined to be in the best interest of the Owner. The Owner reserves the right to revoke the pre-qualification of any bidder in accordance with Section 39-2-4, Code of Alabama, 1975, as amended in 1997 (by Act 97-225).

D. PRE-BID CONFERENCE:
A Pre-bid Conference will be held on Thursday, August 27, 2009 at 1:00 pm in the Birmingham Zoo Auditorium followed by a visit to the project site. All interested prime contractor bidders and their Subcontract bidders are strongly encouraged to attend.

END

Dates of Advertisement: August 9, August 16, August 23

Publications to run ad: Birmingham News
                             Birmingham Times
                             Huntsville Times
                             Tuscaloosa News
                             Montgomery Advertiser
PART ONE - GENERAL

1.00 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to and form a part of this Section.

1.01 INTENT
A. This section is included in the Bid Documents to give information required to properly prepare the Bids and are hereby made a part of the Contract Documents.

1.02 SCOPE
A. Each Prime Contractor shall submit a LUMP SUM BASE BID proposal which shall include all costs the selected Scope of Work Package and all systems, services and structures as required for this project as provided in the construction documents.
B. It is the intent of these documents to require the contractor to include in his bid all costs involved in the coordination of trades and subcontracts required for the successful completion of the selected Scope of Work Package as specifically outlined, required, or reasonably implied. Coordination and communication with other Prime Contractors is likewise intended in order to facilitate the overall progress of the project.
C. A PRE-BID CONFERENCE will be held as indicated in the INVITATION TO BID.
D. The Owner has elected to pre-qualify Bidders. Bidders must comply with the following:
   a. Submit AIA form A305, Contractor’s Qualification Statement.
   b. Submit photo static copy of Alabama General Contractor’s license.
   c. Successful completion of 3 projects within the last 5 years of similar cost, scope, duration and complexity.
   d. Bonding company has an A.M. Best rating of “A-” or better.
   e. Bid project must represent less than fifty percent (50%) of the annual dollar volume of the applicant’s like work.

1.03 PROPOSAL
A. All bids submitted shall be prepared in conformity with and shall be based upon and submitted, subject to all requirements of the Specifications and Drawings.
B. Bid Documents shall be enclosed in an envelope which shall be sealed and clearly labeled.

1.04 BID PROCEDURE
A. The Owner reserves the right to waive informalities and/or technicalities, to reject any or all bids without explanation to bidders, and to make award as best interest to Owner appears.
B. No bidder may withdraw his bid for sixty (60) days after scheduled time and date set for opening thereof.

1.05 EXPLANATION AND INTERPRETATIONS

A. Should any omission, discrepancy, ambiguity, or area in the Drawings and Specifications, or in any of the Contract Documents be discovered, or should there be any doubt as to the meaning or intent thereof, report such findings to the Architect in writing. Questions should be received by the Architect at least five (7) business days prior to the date set for receiving of bids.

1.06 SUBSTITUTIONS

A. To obtain approval to use unspecified products, Bidders shall submit written request at least ten (10) days before the bid date and hour.

1.07 TIME FOR COMPLETION

A. Time for completion of the total contract shall be three hundred (300) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

B. Time for completion of the LAIR complex shall be two hundred twenty five (225) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

C. Time for completion of the Safari Café, Restroom Building and Dining Pavilion shall be two hundred sixty five (265) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5

1.08 PRE-CONSTRUCTION CONFERENCE

A. Prior to beginning any work on this project, a meeting shall be held with the Program Manager and Architect to review the requirements as they relate to the work schedule, method of approach, and bring attention to all specific job requirements.

1.09 PROTECTION OF EXISTING STRUCTURE

A. The existing facility is to remain in operation and secure during the full duration of the construction activities. The Contractor is to coordinate the use of premises for construction operations, including use of Project site, during the construction period with the appropriate Owner representative. Contractor is to protect existing buildings, including utilities and building services, structural elements, exterior and interior finishes. Any damage is to be repaired at no additional cost to the Owner in a manner satisfactory to the Owner and Architect.

1.10 TEMPORARY FACILITIES PROVIDED BY THE CONTRACTOR

A. The Contractor shall provide all temporary facilities necessary for the completion of the work.

1.11 COMPLIANCE WITH LOCAL REQUIREMENTS

A. All work shall be accomplished in accordance with applicable sections of all Local, County, State and Federal Law, Codes or Ordinances. Owner will pay for Building Permit, contractor shall be responsible for all other fees, permits, impact fees, licenses, etc.
00100 - INSTRUCTIONS TO BIDDERS

1.12 PROJECT FINAL ACCEPTANCE

A. Contractor shall submit to Program Manager before final acceptance and final payment all warranties, guarantees, lien waivers, and surety bonds. All such documents shall show the name and location of the project and the name of the Owner.

END OF SECTION
00201 - BID PACKAGE ONE PROPOSAL

TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 1 - SITE General Trades for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of __________________________ ($__________________________) DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates

   Alternate No. 1 - Radiant floor heat in Elephant Holding Building   ADD $________________________

   Alternate No. 2 - Shade canopies at Elephant Holding Building   ADD $________________________

   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $________________________

   Alternate No. 4 - Solotube Skylights at Café and Restroom   ADD $________________________

   Alternate No. 5 - Solar hot water heater at Restroom   ADD $________________________

   Alternate No. 6 - NOT USED

   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas   ADD $________

   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $________________________

   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $________________________

   Alternate No. 9 - NOT USED

   Alternate No. 10 - Schedule 80 pipe at LSS systems   ADD $________________________

   Alternate No. 11A - Event Yard Path Concrete Paving   ADD $________________________

   Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving   ADD $________________________

   Alternate No. 12: Shade Structure at Elephant Yards.   ADD $________________________

   Alternate No. 13: Sarnafil Roofing System   ADD $________________________

 Trails of Africa
 Birmingham Zoo
 June 24, 2009

FORM OF PROPOSAL
00201-1
Alternate No. 14: Camera System  ADD $__________________
Alternate No. 15: Audio Visual System  ADD $__________________

**Total of All Alternates Bid**  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder's guaranty, if it is a cashier's check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

```
ADDENDUM NO. 1 DATED ____________________________
ADDENDUM NO. 2 DATED ____________________________
ADDENDUM NO. 3 DATED ____________________________
```

**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00201 - BID PACKAGE ONE PROPOSAL

BY: _______________________ TITLE: ________________________________

COMPANY: ____________________________________________________________

ADDRESS: __________________________________________________________________________

MAILING ADDRESS: _________________________________________________________________

TELEPHONE: ___________________ CONTRACTOR’S LICENSE NO.: ________________

CONTRACTOR’S CLASSIFICATION: ________________________________________________

DATE: ______________________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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<td></td>
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TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 2 - BUILDING GENERAL TRADES for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of __________________________ ($__________________________) DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates
   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $____________________
   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $____________________
   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $____________________
   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $____________________
   Alternate No. 5 - Solar hot water heater at Restroom ADD $____________________
   Alternate No. 6 - NOT USED
   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $__________
   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $______________
   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $______________
   Alternate No. 9 - NOT USED
   Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $____________________
   Alternate No. 11A - Event Yard Path Concrete Paving ADD $____________________
   Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving ADD $____________
   Alternate No. 12: Shade Structure at Elephant Yards. ADD $____________________
   Alternate No. 13: Sarnafil Roofing System ADD $____________________
Alternate No. 14: Camera System  ADD $__________________

Alternate No. 15: Audio Visual System  ADD $__________________

Total of All Alternates Bid  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder’s guaranty, if it is a cashier’s check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

ADDENDUM NO. 1  DATED __________________________
ADDENDUM NO. 2  DATED __________________________
ADDENDUM NO. 3  DATED __________________________

NOTES:  
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00202 - BID PACKAGE TWO PROPOSAL FORM

BY: ________________________ TITLE: ________________________________

COMPANY: __________________________________________________________

ADDRESS: __________________________________________________________

MAILING ADDRESS: _________________________________________________

TELEPHONE: ______________________ CONTRACTOR'S LICENSE NO.: __________

CONTRACTOR'S CLASSIFICATION: _________________________________

DATE: __________________________________________________________________

Trails of Africa
Birmingham Zoo
June 24, 2009
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an **allowance** for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

**Clarification Note:** The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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00203 – BID PACKAGE THREE PROPOSAL FORM

TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

June 24, 2009

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 3 - LIFE SUPPORT AND FILTRATION for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of ___________________________ ($__________________________) DOLLARS.

A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates

Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $________________________
Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $________________________
Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $________________________
Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $________________________
Alternate No. 5 - Solar hot water heater at Restroom ADD $________________________
Alternate No. 6 - NOT USED
Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $__________
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Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $________________________
Alternate No. 9 - NOT USED
Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $________________________
Alternate No. 11A - Event Yard Path Concrete Paving ADD $________________________
Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving ADD $________________________
Alternate No. 12: Shade Structure at Elephant Yards. ADD $________________________
Alternate No. 13: Sarnafil Roofing System ADD $________________________
5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

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12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

   - ADDENDUM NO. 1 DATED __________________________
   - ADDENDUM NO. 2 DATED __________________________
   - ADDENDUM NO. 3 DATED __________________________

**NOTES:**

If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00203 - BID PACKAGE THREE PROPOSAL FORM

BY: _________________________ TITLE: _________________________

COMPANY: __________________________________________________________

ADDRESS: __________________________________________________________

MAILING ADDRESS: _________________________________________________

TELEPHONE: _________________________ CONTRACTOR'S LICENSE NO.: __________

CONTRACTOR'S CLASSIFICATION: ______________________________________

DATE: ______________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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<td>10 cubic yards</td>
<td></td>
</tr>
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TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 4 - ELECTRICAL for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of ___________________ ($________________________) DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates
   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $________________________
   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $________________________
   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $________________________
   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $________________________
   Alternate No. 5 - Solar hot water heater at Restroom ADD $________________________
   Alternate No. 6 - NOT USED
   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $__________
   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $________________________
   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $________________________
   Alternate No. 9 - NOT USED
   Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $________________________
   Alternate No. 11A - Event Yard Path Concrete Paving ADD $________________________
   Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving ADD $________________________
   Alternate No. 12: Shade Structure at Elephant Yards. ADD $________________________
   Alternate No. 13: Sarnafil Roofing System ADD $________________________
Alternate No. 14: Camera System  ADD $__________________
Alternate No. 15: Audio Visual System  ADD $__________________

Total of All Alternates Bid  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder’s guaranty, if it is a cashier’s check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

ADDENDUM NO. 1 DATED ____________________________
ADDENDUM NO. 2 DATED ____________________________
ADDENDUM NO. 3 DATED ____________________________

**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00204 - BID PACKAGE FOUR PROPOSAL FORM

BY: __________________________ TITLE: ________________________________

COMPANY: ____________________________________________________________

ADDRESS: ____________________________________________________________

MAILING ADDRESS: ____________________________________________________

TELEPHONE: __________________ CONTRACTOR'S LICENSE NO.: ______________

CONTRACTOR'S CLASSIFICATION: _________________________________________

DATE: ________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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TO: Birmingham Zoo, Inc.  
2630 Cahaba Road  
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for **Bid Package 5 - PLUMBING** for the Trails of Africa exhibit at the Birmingham Zoo located at **2630 Cahaba Road, Birmingham, Alabama**.

2. All in accordance with said Contract Documents as prepared by **CLR Design Inc.** for the Birmingham Zoo, and dated **June 24, 2009** for the sum of __________________________________________$_{___________________________}$ DOLLARS.
   
   **A. Attachment A to the Proposal Form: Unit Prices**

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates
   
   Alternate No. 1 - Radiant floor heat in Elephant Holding Building;   ADD $________________________
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   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $________________________
   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $________________________
   Alternate No. 5 - Solar hot water heater at Restroom ADD $________________________
   Alternate No. 6 - NOT USED
   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $_______________
   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $_______________
   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $_______________
   Alternate No. 9 - NOT USED
   Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $________________________
   Alternate No. 11A - Event Yard Path Concrete Paving ADD $________________________
   Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving ADD $________________________
   Alternate No. 12: Shade Structure at Elephant Yards. ADD $________________________
   Alternate No. 13: Sarnafil Roofing System ADD $________________________
Alternate No. 14: Camera System  ADD $__________________

Alternate No. 15: Audio Visual System  ADD $__________________

Total of All Alternates Bid  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder's guaranty, if it is a cashier’s check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

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ADDENDUM NO. 1 DATED ____________________________
ADDENDUM NO. 2 DATED ____________________________
ADDENDUM NO. 3 DATED ____________________________
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**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00205 - BID PACKAGE FIVE PROPOSAL FORM

BY: ___________________________ TITLE: ___________________________

COMPANY: ____________________________________________________________

ADDRESS: ____________________________________________________________

MAILING ADDRESS: ____________________________________________________

TELEPHONE: ___________________________ CONTRACTOR'S LICENSE NO.: __________

CONTRACTOR'S CLASSIFICATION: __________________________________________

DATE: ____________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

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TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 6 - H.V.A.C. for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of ______________________($____________________) DOLLARS.

A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates

   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $________________________

   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $____________________

   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $____________________

   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $________________________

   Alternate No. 5 - Solar hot water heater at Restroom ADD $________________________

   Alternate No. 6 - NOT USED

   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $________

   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $_______________

   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $_______________

   Alternate No. 9 - NOT USED

   Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $________________________

   Alternate No. 11A - Event Yard Path Concrete Paving ADD $________________________

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Trails of Africa
Birmingham Zoo
June 24, 2009
Alternate No. 14: Camera System  ADD $__________________
Alternate No. 15: Audio Visual System  ADD $__________________
Total of All Alternates Bid  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder's guaranty, if it is a cashier's check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

ADDENDUM NO. 1 DATED ____________________________
ADDENDUM NO. 2 DATED ____________________________
ADDENDUM NO. 3 DATED ____________________________

**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00206 - BID PACKAGE SIX PROPOSAL FORM

BY: __________________________ TITLE: __________________________

COMPANY: ________________________________________________________

ADDRESS: __________________________________________________________________________

MAILING ADDRESS: _________________________________________________________________

TELEPHONE: __________________________ CONTRACTOR'S LICENSE NO.: ________________

CONTRACTOR'S CLASSIFICATION: ____________________________________________________

DATE: ______________________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance

Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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<td>Mason’s Sand</td>
<td>10 cubic yards</td>
<td></td>
</tr>
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</table>
00207 - BID PACKAGE SEVEN PROPOSAL FORM

TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 7 - COMBINATION OF PACKAGE 5 PLUMBING AND PACKAGE 6 H.V.A.C. for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of _______________$_________________________ DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates

   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $_______________
   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $_______________
   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $_______________
   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $_______________
   Alternate No. 5 - Solar hot water heater at Restroom ADD $_______________
   Alternate No. 6 - NOT USED
   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $___________
   Alternate No. 7B - Stamped & Colored Concrete Paving at Café Plaza ADD $_______________
   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $_______________
   Alternate No. 9 - NOT USED
   Alternate No. 10 - Schedule 80 pipe at LSS systems ADD $_______________
   Alternate No. 11A - Event Yard Path Concrete Paving ADD $_______________
   Alternate No. 11B - Event Yard Path Stamped & Colored Concrete Paving ADD $_______________
   Alternate No. 12: Shade Structure at Elephant Yards. ADD $_______________
   Alternate No. 13: Sarnafil Roofing System ADD $_______________
00207 - BID PACKAGE SEVEN PROPOSAL FORM

Alternate No. 14: Camera System  ADD $__________________

Alternate No. 15: Audio Visual System  ADD $__________________

Total of All Alternates Bid  ADD $__________________

5. Time for completion of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. Time for completion of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. Time for completion of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder’s guaranty, if it is a cashier's check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

ADDENDUM NO. 1  DATED ____________________________
ADDENDUM NO. 2  DATED ____________________________
ADDENDUM NO. 3  DATED ____________________________

NOTES:
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 8 - ROCKWORK for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of $___________________ DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates
   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $___________________
   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $___________________
   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $___________________
   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $___________________
   Alternate No. 5 - Solar hot water heater at Restroom ADD $___________________
   Alternate No. 6 - NOT USED
   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $_________
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   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $_______________
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   Alternate No. 11A - Event Yard Path Concrete Paving ADD $___________________
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   Alternate No. 12: Shade Structure at Elephant Yards. ADD $___________________
   Alternate No. 13: Sarnafil Roofing System ADD $___________________
Alternate No. 14: Camera System ADD $__________________

Alternate No. 15: Audio Visual System ADD $__________________

Total of All Alternates Bid ADD $__________________

5. Time for completion of the total contract shall be three hundred (300) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. Time for completion of the LAIR complex shall be two hundred twenty five (225) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. Time for completion of the Safari Café, Restroom Building and Dining Pavilion shall be two hundred sixty five (265) calendar days from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. LIQUIDATED DAMAGES will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder’s guaranty, if it is a cashier’s check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

ADDENDUM NO. 1 DATED ____________________________
ADDENDUM NO. 2 DATED ____________________________
ADDENDUM NO. 3 DATED ____________________________

NOTES:
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.
00208 - BID PACKAGE EIGHT PROPOSAL FORM

BY: __________________________________ TITLE: ____________________________________

COMPANY: ________________________________________________________________

ADDRESS: ________________________________________________________________

MAILING ADDRESS: ________________________________________________________

TELEPHONE: ______________________ CONTRACTOR'S LICENSE NO.: ______________

CONTRACTOR'S CLASSIFICATION: ____________________________________________

DATE: ______________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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<td>Mason's Sand</td>
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00209 - BID PACKAGE NINE PROPOSAL FORM

TO: Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Bid Package 9 - LANDSCAPE AND IRRIGATION for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of ______________________________ DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates

   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $______________

   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $______________

   Alternate No. 3 - Electric radiant heaters at Café Seating Pavilion (Room 517) and West Patio (Room 506) ADD $______________

   Alternate No. 4 - Solotube Skylights at Café and Restroom ADD $______________

   Alternate No. 5 - Solar hot water heater at Restroom ADD $______________

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   Alternate No. 7A - Stamped & Colored Concrete Paving at Café Dining Areas ADD $___________

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   Alternate No. 8 - Stamped & Colored Concrete Paving at Visitor Paths ADD $___________

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   Alternate No. 11A - Event Yard Path Concrete Paving ADD $______________

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   Alternate No. 12: Shade Structure at Elephant Yards. ADD $______________

   Alternate No. 13: Sarnafil Roofing System ADD $______________
5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

6. **Time for completion** of the LAIR complex shall be **two hundred twenty five (225) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

7. **Time for completion** of the Safari Café, Restroom Building and Dining Pavilion shall be **two hundred sixty five (265) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

8. **LIQUIDATED DAMAGES** will be assessed in favor of the owner for failure to achieve substantial completion within the allotted time. Refer to A201 General Conditions of the Contract.

9. In submitting this bid, it is understood that the Owner reserves the right to reject any and all bids and that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

10. Only the successful bidder agrees that if written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned, he will within ten (10) days after date of such notice execute and deliver a Contract and required bonds in accordance with the Specifications.

11. The undersigned further agrees that in case of failure on his part to execute the Contract and required Contract bonds within ten (10) consecutive days after being given written notice of award of this Contract, the Owner shall retain from the Bidder’s guaranty, if it is a cashier’s check, or from the surety, if the guaranty is a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest bidder. If no other bids are received, the full amount of the guaranty shall be retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the Owner.

12. In submitting this bid, the undersigned certifies that there has been no collusion with any person in respect to this bid or any other bid or the submitting of bids for the Contract for which this bid is submitted.

13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

   ADDENDUM NO. 1 DATED ____________________________
   ADDENDUM NO. 2 DATED ____________________________
   ADDENDUM NO. 3 DATED ____________________________

**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of Incorporation under signature; and if partnership, give full names of all partners.

 Trails of Africa  
Birmingham Zoo  
June 24, 2009
00209 - BID PACKAGE NINE PROPOSAL FORM

BY: __________________________________ TITLE: ________________________________

COMPANY: ________________________________________________________________

ADDRESS: __________________________________________________________________

MAILING ADDRESS: __________________________________________________________

TELEPHONE: ________________________ CONTRACTOR'S LICENSE NO.: ______________

CONTRACTOR'S CLASSIFICATION: _____________________________________________

DATE: ________________________________________________________________________
ATTACHMENT ‘A’ TO PROPOSAL FORM

STATED ALLOWANCES AND UNIT PRICES

The following items of work are anticipated during construction of this contract; however the exact quantity of each work item may not be determinable prior to bidding. The Contractor, shall therefore, include in his Lump Sum Base and / or Alternates Bid (as applicable), an allowance for the following items in the quantities indicated: Allowance Unit Prices include all charges for labor, materials and equipment, shoring, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Allowance item(s). Where quantities of same items of work are defined and are quantified in the bid documents, the allowance quantities indicated hereinafter shall be in addition to those which are indicated. (Example: If the site grading plan indicates new and existing grades, the bidder shall compute the quantity of earthwork required and include that quantity of work in the bid the same as if no “allowance quantity were specified. If an additional allowance quantity of earthwork is stipulated, that stipulated allowance quantity of work shall also be included in addition to the quantity computed from the bidders earthwork “takeoff”).

The following Unit Prices Quoted are for increases or decreases in the above quantities included in the Lump Sum Base and/or Alternate Bids. These Unit Prices include all charges for labor, materials and equipment, fee, layout, supervision (field and home office), general expenses, taxes, insurances, overhead and profit, but not limited to, for accomplishment of the Unit Price item(s).

Clarification Note: The Unit Prices quoted by the Contractor shall apply to increases (additive change orders) and to decreases (deductive change orders). This requirement shall supplement the requirements of the General Conditions, and Instructions to Bidders. Changes in the contract amount which are computed using the Stated Allowances and Unit Prices shall be figured at the same unit price whether additive or deductive.
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TO: Birmingham Zoo, Inc.  
2630 Cahaba Road  
Birmingham, AL 35216

1. The undersigned having carefully examined the Contract Documents, the site of the Work, and the conditions affecting the Work, hereby proposes and agrees, if this proposal is accepted, to enter into Contract, furnish bonds in the forms specified and to furnish all labor and materials required for Package 10 - SITE BARRIERS AND HARDSCAPE for the Trails of Africa exhibit at the Birmingham Zoo located at 2630 Cahaba Road, Birmingham, Alabama.

2. All in accordance with said Contract Documents as prepared by CLR Design Inc. for the Birmingham Zoo, and dated June 24, 2009 for the sum of ________________________________ ($__________________________) DOLLARS.

   A. Attachment A to the Proposal Form: Unit Prices

3. The undersigned must submit a complete breakdown of labor and material to be used in the project, including those estimated by the subcontractor. The breakdown should estimate labor cost and material cost at the divisional level and follow the format as provided on the Contractor's pay request. The requirement must be met before any funds will be released to the Contractor.

4. Alternates
   Alternate No. 1 - Radiant floor heat in Elephant Holding Building; ADD $__________________
   Alternate No. 2 - Shade canopies at Elephant Holding Building. ADD $__________________
   Alternate No. 3 - Electric radiant heaters at Café Seating Pavillon (Room 517) and West Patio (Room 506) ADD $__________________
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   Alternate No. 12: Shade Structure at Elephant Yards. ADD $______________
   Alternate No. 13: Sarnafil Roofing System ADD $______________
Alternate No. 14: Camera System  ADD $__________________
Alternate No. 15: Audio Visual System  ADD $__________________
Total of All Alternates Bid  ADD $__________________

5. **Time for completion** of the total contract shall be **three hundred (300) calendar days** from “Notice to Proceed” as adjusted per Supplemental General Conditions, Section 00800, Paragraph 3.10.5.

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13. I hereby certify that we do not discriminate in employment of our personnel against any person or persons, on account of race, creed, color, sex, or national origin.

14. The receipt of the following addenda is acknowledged:

   ADDENDUM NO. 1  DATED  ____________________________
   ADDENDUM NO. 2  DATED  ____________________________
   ADDENDUM NO. 3  DATED  ____________________________

**NOTES:**
If Bidder is a Corporation, state name of officer certified by Board of Directors to execute Contract binding Corporation; write State of incorporation under signature; and if partnership, give full names of all partners.

**Trails of Africa**
**Birmingham Zoo**
**June 24, 2009**
00209 - BID PACKAGE NINE PROPOSAL FORM

BY: ___________________________________ TITLE: ____________________________________________

COMPANY: ____________________________________________________________

ADDRESS: _______________________________________________________________________

MAILING ADDRESS: __________________________________________________________________

TELEPHONE: _________________________ CONTRACTOR'S LICENSE NO.: _______________________

CONTRACTOR'S CLASSIFICATION: _________________________________________________

DATE: ______________________________________________________________________________
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December 4, 2007

Mr. William Foster
Birmingham Zoo, Inc.
2630 Cahaba Road
Birmingham, Alabama 35233

Subject: Report of Subsurface Exploration and Geotechnical Engineering Evaluation
Trails of Africa Exhibit – Birmingham Zoo
Birmingham, Alabama
BHATE Project Number: 107309

Dear Mr. Foster:

Bhate Geosciences Corporation (BHATE) has completed the authorized subsurface exploration at the subject site. We are pleased to submit the following report of our findings and recommendations. Our work was performed in general accordance with our Proposal Number #4410-07 dated November 5, 2007.

The purpose of our study was to determine general subsurface conditions at specific soil boring locations, and to gather information on which to base our evaluation regarding site development and building foundation considerations. We understand that the project is in early stages and as further design of this project progresses, we suggest that our office be contacted regarding foundation design, earthwork specifications and construction documents so that we may provide additional input related to site-specific subsurface conditions.

We appreciate the opportunity to work with you on this project and look forward to our continued association with during design and construction. If you have any questions or need additional information, please contact us at your convenience.

Respectfully submitted,
BHATE GEOSCIENCES CORPORATION

[Drew Thornbury, EIT
Staff Professional]

[Uday R. Bhate, P.G., P.E.
Senior Principal]

QUALITY • SERVICE • EXCELLENCE
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# APPENDIX

BORING LOCATION PLAN
LOGS OF BORING
IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT
1.0 **SCOPE OF WORK**

The purpose of the geotechnical exploration was to obtain information regarding general subsurface conditions at specific locations within the proposed Birmingham Zoo African Trail exhibition. The results of our field exploration completed to date are presented in this report, and include the following items:

1. Review of available geological literature including published geologic maps.

2. Nine (9) soil test borings were performed within proposed exhibit areas. The exhibit area borings were advanced to either 15' or auger refusal, whichever was less. *Boring location 6 located within the proposed restroom facility could not be drilled due to access problems.*

3. Laboratory analysis was performed on representative soil samples from the borings. Laboratory tests included soil moisture content, Atterberg limits, and grain size analysis.

4. Preparation of our geotechnical engineering report to address the following items:
   - Evaluation of site geology and surface conditions.
   - Subsurface conditions encountered at the soil test boring locations.
   - Laboratory test results.
   - Site preparation and grading considerations.
   - Foundation recommendations, including foundation type, bearing pressures, and anticipated bearing levels.
   - Retaining wall considerations.

The scope of services represented by this report does not include an environmental assessment or exploration for the presence or absence of floodways, wetlands, or hazardous or toxic materials at the site.
2.0 SITE AND PROJECT DESCRIPTION

The Birmingham Zoo is located at 2630 Cahaba Rd in Birmingham, AL. The proposed expansion to the Zoo is located on the south side of the existing facility. Currently the proposed area contains a number of exhibits and buildings including the Bison Range, the Cheetah Exhibit, Bird Island and an existing Refreshment Building. The area surrounding the existing exhibits is primarily composed of landscaped areas and concrete walkways. Some areas of the proposed expansion are located in wooded areas south of the existing exhibits. Site preparation was required in order to gain access to these areas. A satellite image of the proposed expansion location can be seen in Figure 1.

![Proposed Expansion Location](image)

Figure 1: Trails of Africa Expansion Location

It is our understanding the proposed project will consist of 4 new buildings that include the following: a new Elephant Holding Facility of approximately 9,000 square feet, new Rhino Holding Facility of approximately 2,300 square feet, new Filtration and Keeper Support Facility of 4,200 square feet, and a new Public Rest Room Facility of 1,200 square feet. The Trails of Africa exhibit will also feature a Lake/River feature and a large Open Air Exhibit for varies animals to roam around. The animals will be contained by using a moat and retaining wall system. Structural information about each building was unavailable at the time of report.

A preliminary site grading plan (which was part of the Bore Hole Location drawing dated 10-25-07) was provided by Dennis Courtney of Hoar Construction. The proposed final grades vary depending on the exhibit location. The following provides the approximate grading requirements for each exhibit:

- The **Elephant Holding Facility** will require up to 3’+ of fill to reach final subgrade at 677.0’.
- The **Rhino Holding Facility** will require up to 5’ of cut to reach final subgrade at 678.0’.
- The **Filtration and Keeper Support Facility** will need up to 3’ of cut to reach final subgrade at 678.0’.
- The **Restroom Facility** will need up to 4’+ of fill to reach final subgrade at 689.5’.
- The **Lake/River Feature** will require cuts ranging from 5’ to 9’.
- The **Moat System of the Open Air Exhibit** will require an 8’ cut on all sides in order to reach the bottom of the moat.
3.0 SITE GEOLOGY

Based on “Engineering Geology of Jefferson County, Alabama, 1979”, the site is located in the Floyd Shale formation approximately 1/4 mile southeast of the geologic contact between the Floyd Shale and the Bangor Limestone Formation.

Floyd Shale typically consists of thin- to medium-bedded fissile shale and siltstone. The shale weathers to a clayey soil that may be as much as 15 feet in thickness. The soil typically has an AASHTO rating of A-6 to A-7, a moderate to high shrink swell potential, and has relatively low permeability causing water ponding and mucky conditions after periods of rain.

In this area, the contact zone between the Floyd Shale and Bangor Limestone has had a history of sinkhole formation. With the proximity to the contact zone, the client should be aware and understand that there is always some risk associated with building over an area that is prone to the formation of sinkholes. Our scope of services did not include specific exploration to determine the presence of subsurface cavities or to determine sinkhole risk.
4.0 SUBSURFACE EXPLORATION

4.1 FIELD EXPLORATION

On November 19, 2007 BHATE conducted a subsurface investigation at the subject site. The borings were located in the field by measuring distances from existing landmarks shown on the site plan provided to us. The locations of the borings are shown on the boring location plan located in the Appendix of this report and should be considered approximate.

4.2 SOIL TEST BORINGS

Within each soil test boring, split-tube sampling and Standard Penetration tests (SPT) were performed in accordance with ASTM D1586. The soil test borings were advanced by mechanically twisting continuous, hollow-stem auger flights into the ground. In the soil test borings, soil samples were obtained with a standard 2-inch O.D., 1.4-inch I.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven one additional foot with blows of a mechanical hammer. The number of blows (N) required to drive the sampler the final foot of penetration is the standard penetration resistance. The penetration resistance, when properly evaluated, is an index to the soil’s strength, density, and ability to support foundations.

Representative portions of the samples obtained from the split-tube sampler were sealed in airtight containers and transported to our laboratory. In the laboratory, the geotechnical engineer classified the samples, and had a limited testing program performed on some representative samples to ascertain additional characteristics of the samples. The Logs of Boring in the Appendix indicate the soil descriptions and penetration resistances.

4.3 LABORATORY TESTING

In addition to the field exploration, a laboratory-testing program was conducted to obtain data on engineering characteristics of subsurface materials. Results of laboratory tests are shown on the respective Log of Boring in the Appendix.

Natural Moisture contents (ASTM D2216) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles. The results of the natural moisture content test taken from site samples ranged from 13.2 to 20.8 percent.

Atterberg Limits (ASTM D4318) was performed on soil sample B-7 at 5’ to determine how the soil characteristics change upon variations in moisture content. The soil Plasticity Index (PI) is representative of these characteristics and is the difference between the Liquid Limit (LL) and the Plastic Limit (PL). The plasticity Index of the soil tested was 11.

Standard Test Method for Amount of Materials in Soil Finer than the No. 200 Sieve (ASTM D1140-97) was performed on soil sample B-8 at 2’. The percentage of soils finer than a number 200 sieve was 62.20 percent passing.
5.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered by the borings are shown on the Logs of Boring in the Appendix. The general subsurface conditions encountered and their pertinent characteristics are described in the following subsections. Conditions represented by the Logs of Boring should be considered applicable only at the boring locations and it should be assumed that the subsurface conditions could be different at other locations or at other times.

5.1 SURFACE CONDITIONS

At the time of our exploration the subject site was located both within the existing zoo area and located in wooded areas south of the exhibits. The areas within the zoo mostly contained lightly landscaped areas with less than 3” of topsoil and concrete sidewalks. Areas within the wooded areas contained topsoil that will range from 6” to 12”, and root systems from the mature trees should be expected to extend to depths of 2+ feet.

5.2 EXISTING FILL

During exploration, fill was found in borings B-7 and B-8 and fill depths ranged from 4’ to 5.5’ below the existing ground surface. The fill encountered at B-7 generally consisted of low consistency sandy clay. The fill was located within the existing zoo, and the fill encountered is likely backfill from previous utilities. The fill encountered at B-8 generally consisted of low consistency brown silty sand.

5.3 RESIDUAL SOIL / DECOMPOSED SHALE

Residual soil is derived from the in-place weathering of parent rock. Residual soil was encountered at all nine boring locations. The residual soil was generally classified as a medium to high consistency silty clay underlain by a high consistency, light gray to light brown, highly decomposed shale. SPT N-values in the residual soil ranged from 12 to 100+.

5.4 AUGER REFUSAL/BORING TERMINATION

During exploration, the borings were to be terminated at a depth of 15’ or at auger refusal. Auger refusal is the depth at which the drill cannot be advanced further by conventional means. The auger refusal material was shale bedrock, and the depths to auger refusal are presented in Table 1.

<table>
<thead>
<tr>
<th>Boring Location</th>
<th>Refusal Depth</th>
<th>Boring Location</th>
<th>Refusal Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>BT at 15’</td>
<td>B-6</td>
<td>13’</td>
</tr>
<tr>
<td>B-2</td>
<td>10’</td>
<td>B-7</td>
<td>n/a</td>
</tr>
<tr>
<td>B-3</td>
<td>BT at 15’</td>
<td>B-8</td>
<td>BT at 15’</td>
</tr>
<tr>
<td>B-4</td>
<td>8’</td>
<td>B-9</td>
<td>BT at 15’</td>
</tr>
<tr>
<td>B-5</td>
<td>BT at 15’</td>
<td>B-10</td>
<td>BT at 15’</td>
</tr>
</tbody>
</table>

*BT = boring termination depth.

Note: It should be noted that prior to auger refusal, several feet of decomposed to weathered shale with SPT values greater than 50 to 100 blows for less than 12” of penetration were encountered in several borings.
5.5 GROUNDWATER

Groundwater was not encountered at any of the boring locations. However, the absence of groundwater during our exploration does not necessarily mean that water will or will not be present at a later time or at other locations. Groundwater levels vary depending on weather, season, and location. The groundwater typically becomes perched at the various soil interfaces and above the bedrock creating soft soil conditions.

6.0 SITE PREPARATION AND FOUNDATION DESIGN CONSIDERATIONS

6.1 ELEPHANT HOLDING FACILITY

6.1.1 Building Characteristics: This structure will be a 9,000 square feet, 30' tall facility with assumed maximum column loads of 100 KIPS. Final floor elevation will be 677.0', and the site work will require about from 0' to 3' of fill.

6.1.2 Site Preparation: Building construction/excavation will require demolition of portions of the existing Cheetah Exhibit which include the fence area on the northwestern portion of the Exhibit. The demolition debris should be removed and properly disposed from the site and should not be used in any engineered fill or future embankments constructed on the project.

Site preparation should include stripping all vegetation, topsoil, organic material, and debris to a depth where uniform, stable subgrade conditions are encountered. The Elephant Holding Facility was located mostly in a wooded area; therefore, topsoil should be anticipated to be between 6" to 9". However, root systems from mature trees could reach depths of up to 24". Topsoil or other such material containing organic matter should not be used as structural fill.

6.1.3 Foundation Design Considerations: We have assumed the column loads for this structure are in the magnitude of 100 kips. Footings may be supported on compacted engineered fill or natural ground and designed for a maximum allowable bearing of 2500 PSF. See Section 9.1 for further shallow foundation recommendations, and see Section 8.1 for engineering fill recommendations.

6.1.4 Slab-On-Grade Design Considerations: Assuming that the site preparation has been performed by removing all soft and unstable soils encountered, the slab can be supported on grade. Specific slab support and design considerations are addressed in Section 10.0 of this report.

6.2 RHINO HOLDING FACILITY

6.2.1 Building Characteristics: The structure will be a single story; 2,300 square foot facility with assumed column loads of up to 70 KIPS. Final floor elevation will be 678.0', and the facility will require anywhere from 0' to 4' of cut to reach sub-grade.

6.2.2 Site Preparation: Building construction will require demolition of the existing Cheetah Building. Demolition commonly results in disturbance of the bearing soils requiring proper restoration of the disturbed soil conditions. Any excavations for underground structures such as footings, utilities etc. that are removed should be properly backfilled with engineered fill. The project demolition and grading specifications should clearly address proper site preparation post demolition of the existing building since the new structure will be supported in this area. Improper management of demolition activities or not removing the substructure during demolition can result in problems and additional costs during subsequent construction activities.
6.2.3 Foundation Design Considerations: We have assumed that the column loads for this structure are in the magnitude of 70 kips. Footings may be supported on natural ground composed of hard residual soils or decomposed shale and designed for a maximum allowable bearing of 3,500 PSF. See Section 9.1 for further shallow foundation recommendations.

6.2.4 Slab-On-Grade Design Considerations: Assuming that the site preparation has been performed by removing all soft and unstable soils encountered, the slab can be supported on grade. Specific slab support and design considerations are addressed in Section 10.0 of this report.

6.3 FILTRATION AND KEEPER SUPPORT FACILITY

6.3.1 Building Characteristics: The structure will be a single story; 4,200 square foot facility with assumed column loads of up to 70 KIPS. Final floor elevation will be 678.0'. However, the facility will require a settling chamber that will be up to 10' below finish floor elevation. Therefore, the facility will require cut sections ranging from 6' to 10' to reach sub-grade.

6.3.2 Site Preparation: The final grade of the basement area will be located in highly decomposed shale. Decomposed shale can most likely be excavated with a large high capacity track-hoe, but there is a potential for encountering unweathered shale rock that will require more intensive excavation methods. We recommend that all excavation for this project be bid on an 'unclassified basis'.

The excavation for this particular building will reach depths ranging from 6' to 10'. Provisions for dewatering and perimeter drains should be included in design. We also recommend the grading and construction plans include provisions for intercepting surface water entering construction from adjacent areas.

6.3.3 Foundation Design Considerations: We have assumed the column loads for this structure are in the magnitude of 70 kips. Footings may be supported on natural ground and designed for a maximum allowable bearing of 3,500 PSF. See Section 9.1 for further shallow foundation recommendations.

6.3.4 Slab-On-Grade Design Considerations: Assuming that the site preparation has been performed by removing all soft and unstable soils encountered, the slab can be supported on grade. Specific slab support and design considerations are addressed in Section 10.0 of this report.

6.4 RESTROOM FACILITY

6.4.1 Building Characteristics: The structure will be a single story; 4,200 square foot facility with assumed column loads of up to 50 KIPS. The restroom will most likely tie into the existing building; therefore, final floor elevation should be expected to be 689.5'. As a result, the facility will require up to 4' of fill to reach sub-grade. Boring location B-6 was unable to be drilled due to access problems so geotechnical exploration was limited. As a result, geotechnical recommendations are based on visual observations.

6.4.2 Site preparation Requirements: The area where boring location B-6 would have been was located in a lightly wooded area with a number of scattered mature trees. Topsoil will likely be less than 6'; however, root systems should be anticipated to reach depths of up to 2'.

Although no exploration at this particular location could be conducted at the building location, some low consistency fill was found at B-7. There is a possibility that low consistency fill exists around the proposed building, and if any is encountered, it will need to be undercut.
Before construction of this area, the geotechnical engineer should evaluate the area. This evaluation should include proofrolling of the exposed sub-grade with a loaded dump truck or similar pneumatic tire-mounted equipment. Proofrolling would serve to reveal soft or loose areas where undercutting or moisture conditioning of the exposed soil may be required.

6.4.3 Foundation Design Considerations: Provided that all soft and unstable soils are removed and replaced with properly compacted engineered fill, the foundations may be supported on engineered fill with designed for a maximum allowable bearing value of 2,500 PSF. See Section 9.1 for further shallow foundation recommendations, and see Section 8.1 for engineering fill recommendations.

6.4.4 Slab-On-Grade Design Considerations: Assuming that the site preparation has been performed by removing all soft and unstable soils, the slab can be supported on grade. Specific slab support and design considerations are addressed in Section 10.0 of this report.

6.5 LAKE/RIVER FEATURE

6.5.1 Feature Characteristics: The feature will consist of a lake/river feature for the exhibit that extends from B-7 to B-5. The lowest elevation of the river/lake is 866', and a retaining wall of up to 8' will be required at some sections of the feature. The cut sections throughout the feature range from 5' to 9'.

6.5.2 Site Prep Considerations: Although B-7 and B-5 encountered auger refusals below 10', high consistency material (SPT > 50) was encountered at about 5' depth and there is a possibility that harder shale will be exposed during excavation. Most of the weathered shale material can most likely be excavated with heavy ripping. However, if harder shale is exposed, more intense excavation means, such as pneumatic hammers and blasting, will be required. We recommend that the excavation at this site be bid on an 'unclassified' basis.

6.5.3 Retaining Walls: Recommendations for the retaining wall are provided in Section 11.0 of this report.

6.6 OPEN AIR EXHIBIT

6.6.1 Feature Characteristics: The feature will consist of a large open field/ savannah that a number of animals will roam around in. The animals will be enclosed by a moat system that covers the exhibit on three sides. The moat system is indicated with an approximate 2H to 1V slope with an adjacent (8' to 10' away) 8' high retaining wall.

6.6.2 Site Preparation: Some fill was noted in the upper zone and may impact the slope construction for this feature. Boring location B-4 had an auger refusal of 8'. Most of the material will most likely be able to be excavated with heavy ripping. However, there is a highly likely chance that harder shale will be exposed above the bottom of some of the cuts and more intense excavation means, such as pneumatic hammers and blasting, will be required. The excavation should be bid on an 'unclassified' basis. Recommendations for the retaining wall can be found in Section 11.0.
7.0 GENERAL SITE PREPARATION CONSIDERATIONS

7.1 FILL PLACEMENT

Prior to fill placement, the areas at subgrade to receive fill should be thoroughly proofrolled with a loaded dump truck in the presence of the geotechnical engineer. Engineered fill at the site should be free of organic matter and other deleterious materials and should be low plasticity (LL less than 45, PI less than 25 and a maximum dry density greater than 105pcf). Based on the limited amount of laboratory testing on the upper on-site soils, it appears that the excavated soils can be reused in engineered fill provided they are free of organic matter and meet the soil properties indicated in this section.

Laboratory tests should be performed on representative samples of off-site borrow soil to determine whether the soil complies with the specified characteristics. It should be the contractor's responsibility to submit any proposed fill samples to the geotechnical engineer at least one week before using the material.

A sufficient number of field density tests should be performed during filling to indicate whether the fill is in general compliance with the project specifications. A commonly used testing frequency is one test per lift of compacted fill per 2,500 square feet of fill area. Lift thickness of general fill should be limited to 8 inches loose measure and compacted to 98% of its Standard Proctor (ASTM D698) maximum dry density. Backfill in limited access areas, such as utility trenches, should have a lift thickness limited to 6 inches loose measure.

7.2 SITE DRAINAGE DURING CONSTRUCTION AND POST CONSTRUCTION

While shallow groundwater was not encountered during drilling, seepage may occur during excavation through the residuum/rock interface following periods of rain. Standard provisions for dewatering during construction should be included in project specifications. We also recommend that the grading and construction plans include provisions for intercepting surface water entering construction from adjacent areas.

7.3 BACKFILLING OF UTILITY TRENCHES

Backfilling of storm drains and utility trenches must be performed in a controlled manner to avoid settlement of the fill and cracking of floor slabs and pavements. We recommend that utility trenches be backfilled with acceptable fill in six-inch lifts compacted with pneumatic piston tampers to the project requirements. Should seepage occur in utility trenches, it may be necessary to "floor" the trench with dense graded gravel to provide a dry working surface. Should crushed stone be used to backfill utility trenches, we recommend that dense graded gravel (compacted in lifts) be used.

Open graded gravel such as ALDOT #57 stone should not be used to backfill utility trenches because it can provide a conduit for water flow from outside to under the building slabs and can detrimentally impact bearing capacity of moisture sensitive soils.
8.0 GENERAL FOUNDATION CONSIDERATIONS

8.1 SOIL SUPPORTED FOUNDATIONS

As discussed in the previous sections, several structures will be supported on shallow foundations bearing on properly compacted engineered fill or natural ground.

Additionally, we recommend that the following items be included in the foundation design and project specifications:

1. Minimum footing dimensions should be 18 and 24 inches for continuous strip footings and individual column footings, respectively.

2. The footing-bearing surface should be observed by a member of the BHATE engineering staff to verify that soil complying with the above recommendations is reached. During field observations, it may be necessary to lower the bearing elevations in order to reach a suitable bearing stratum.

3. The base of all satisfactory foundation excavations should be protected against any detrimental change in conditions, such as disturbance from rain, frost, or flooding. Surface runoff should be drained away from the excavation and not be allowed to pond. Conversely, the foundation bearing soils should not be excessively dry immediately prior to concrete placement for footings. A thin concrete "mud seal" poured over bearing surfaces could be used to protect them from any seepage, which might enter foundation excavations.

4. If possible, all footing concrete should be poured during the same day the excavation is made. If this is not possible, then the footing excavation should be adequately protected. When left unprotected, the bearing soils exposed in the footing bottoms will degrade rapidly when exposed to free water, necessitating additional excavation.

5. Seasonal perched water conditions could exist at shallow depths at the subject site. Therefore, the project specifications and the budget should include provisions for the dewatering of foundation excavations should this condition arise.
9.0 FLOOR SLABS CONSTRUCTION CONSIDERATIONS

For building slab-on-grade support, we have recommended that all low consistency soils encountered be undercut and replaced with properly compacted engineered fill. Following undercutting and prior to placing new fill, the existing subgrade should be evaluated by the geotechnical engineer. Areas that are determined to be unstable, should be further undercut and replaced with engineered fill, or improved to an acceptable condition by other methods such as stabilization. Once the evaluation is complete, placement of structural fill can proceed in the slab area.

We recommend that all ground-supported slabs be founded on a minimum of 6-inches of vibro-compacted granular material (such as ALDOT #57 stone) in order to achieve more uniform support, and to act as a capillary break. A maximum particle size of 1-inch is recommended for the underslab granular material. In order to control slab cracking, PCA and ACI guidelines should be followed.

On most projects, there is some delay between initial grading and the time when the contractor is ready to construct the slab-on-grade. Even though the upper subgrade soil may have been placed and compacted adequately during initial grading, exposure to weather, construction traffic, etc., can damage the integrity of subgrade soil. Restoration of the floor slab subgrade just prior to placement of granular capillary break materials and construction of the slab should be addressed in the project specifications.

Based on the anticipated subgrade soils after removal and replacement of unstable fill, a subgrade modulus value of 125 Pci is recommended in slab design. Higher values may be achieved by using select materials or increasing the thickness of stone base under the slab.
10.0 RETAINING WALLS

Walls that are free to deflect after backfilling can be designed for an “active pressure” condition. Building walls that also function as retaining walls and are restricted from movement should be designed for an “at rest” pressure condition. The design earth pressure is also a function of the type of material retained, slope profile, surcharge loads, hydrostatic conditions, and potential for future loading.

Based on this preliminary information available, the following design parameters are provided for this project:

A. FOR WALLS THAT ARE BACKFILLED WITH FREE-DRAINING GRANULAR MATERIAL (compacted to a minimum 95 percent Standard Proctor ASTM D698) IN a 45° WEDGE EXTENDING UP FROM THE WALL FOUNDATION. Under this condition, the following design parameters are recommended.

<table>
<thead>
<tr>
<th>Active Pressure</th>
<th>35 pcf</th>
</tr>
</thead>
<tbody>
<tr>
<td>At-Rest-Pressure</td>
<td>55 pcf</td>
</tr>
<tr>
<td>Soil Unit Weight</td>
<td>110 pcf (ALDOT #57 Stone)</td>
</tr>
</tbody>
</table>

B. We recommend that once the design concept is finalized, the geotechnical engineer should review the retaining wall design parameters with the structural engineer for final design.

C. The earth pressures discussed above are based on a fully drained condition. Retaining walls should be provided with weep holes and foundation drainage as appropriate. Foundation or perimeter drains should be sufficiently below the floor slab subgrade and achieve positive relief to provide a moisture free slab and basement area.

D. Retaining and basement walls designed for “Active Pressure” conditions are anticipated to move after backfill is placed. In order to achieve the active state in granular soils the displacement must be approximately 0.001 to 0.004 of the wall’s height. In clayey soils it may vary from 0.01 to 0.04 of the wall’s height.

It should be noted that recommendations in this report are not intended for design of segmental modular walls should not be used for that purpose.
11.0 CONSTRUCTION OBSERVATION AND TESTING

We recommend that BHATE be retained to provide a comprehensive construction materials testing program to assist the owner in determining that certain aspects of construction are carried out in general conformance with the plans and specifications. Such a program includes testing of construction materials, such as compacted fill, asphalt and concrete, and engineering observations and testing during earthwork and foundation construction.

Observation and testing during the earthwork and foundation construction phases is particularly important because assumptions and recommendations have been made based on data obtained from a limited number of soil test borings. Confirmation by the design geotechnical engineer that actual subsurface conditions are comparable to the assumed conditions is an essential part of the subsurface evaluation. Failure to engage the geotechnical engineer during the earthwork and building foundation phases of the project will result in an incomplete geotechnical evaluation being conducted and could increase the owner's risk.

12.0 GENERAL REMARKS AND REPORT LIMITATIONS

This report has been prepared for the exclusive use of William Foster of Birmingham Zoo Inc. for specific application to the subject project, and is non-transferable. All recommendations contained in this report have been made in accordance with generally accepted soil and foundation engineering practices. No other warranties are implied or expressed.

The findings discussed in this report are based, in part, upon the data obtained from widely spaced soil test borings. The nature and extent of variations between the test borings may not become evident until after construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

It is important that the geotechnical engineer be provided the opportunity to review the final plans and specifications to verify that the recommendations in this report are properly interpreted and incorporated in the design. Construction and design problems can occur due to misinterpretation of information in the geotechnical report. It is highly recommended that contact be maintained with the geotechnical engineer during the design phase of the project. The geotechnical engineer of record should also follow through during the construction phase to verify that the design recommendations are consistent with the actual field conditions.
1.00 GENERAL

A. The following documents, prepared by the American Institute of Architects shall apply to and form a part of the Contract Documents for this project.

- **AIA A101** Contract Agreement for Construction
- **AIA A201** General Conditions of the Contract for Construction
- **AIA A310** Bid Bond
- **AIA A312** Performance Bond and Payment Bond
- **AIA G701** Change Order
- **AIA G703** Continuation Sheet for G702
- **AIA G704** Certificate of Substantial Completion
- **AIA G706** Contractor's Affidavit of Payment of Debts and Claims
- **AIA G706A** Contractor's Affidavit of Release of Liens
- **AIA G707** Consent of Surety of Final Payment

B. Copies of the printed AIA Documents, are on file and may be referred to at the office of the Architectural Division of the Department of Planning and Engineering (Room 410, City Hall) during normal working hours: 8:00 a.m. to 5:00 p.m., Monday through Friday.

C. Copies of the printed AIA Documents, may be purchased from the office of the Birmingham Chapter of the American Institute of Architects, 107 South 21 Street, Birmingham, Alabama or from the American Institute of Architects, 1735 New York Avenue, NW, Washington, D.C. 20006.
PART ONE - GENERAL CONDITIONS

A. The “General Conditions of the Contract for Construction,” AIA Document A201/CMa American Institute of Architect's, 1992 Edition, Article 1 through 14 inclusive, hereinafter referred to as the General Conditions, are hereby, except as the same may be inconsistent herewith, made a part of this Specification.

B. Where any article of the General Conditions is modified, added or deleted herein, the unaltered provisions of that Article shall remain in effect except for the supplemental provisions of those Article(s) specifically amended, voided, or superseded.

C. The General Conditions govern all sections of the specifications and are as binding as if repeated therein.

D. A Copy of the printed form AIA Document No. A201/CMa 1992, modified for use on this project, is attached to this section

E. Substitute the term “Program Manager” wherever the term “Construction Manager” appears within the A201/CMa General Conditions document.

END OF SECTION
1. INTRODUCTION OF PROGRAM MANAGER: Where the term “Construction Manager” or “Program Manager” are used throughout the contract documents they are one in the same. A Program Manager will perform in the role of Program Manager/Contract Manager for this project. The Program Manager’s primary role will be to oversee the performance of the work, contract administration and monitor the overall project schedule. The following is a list of activities that the Program Manager will be involved in on this project:

   a. Pay Applications: Will review for accuracy prior to submitting to Architect for approval.

   b. Change Order Review and Process: Will handle the review and issuance of all change orders on behalf of the Owner.

   c. Job Progress and coordination Meeting: The Program Manager will hold weekly job progress meetings. This meeting is to discuss current or upcoming issues in regards to the overall project.

   d. RFI: Will receive, track and perform preliminary review of Requests for Information (RFAs), generated by the contractors.

   e. Schedule Update: Will maintain the Overall Project Schedule and issue periodic updates to all parties.

   f. Budget: Will maintain the Overall Project Budget to track actual costs against budgeted costs, and will issue periodic updates to all parties.

   g. Submittals: Will receive submittals and shop drawings from the contractors, process the information and distribute to the architect/engineer for review. Will subsequently receive and distribute the information after review.

   h. Field Observation Reports: Will generate daily field observation reports to document the progress of the project and note items of particular interest. Field Observation reports will be filed on-site.

2. REQUIRED PROJECT MANAGEMENT FORMS: The following is a list of forms that the Program Manager/Contract Manager is requesting from each Contractor. These forms will be used to help monitor the overall progress of the project. Please note the following:

   a. Buyout Log: This is a log that will show all material suppliers to be used for any particular scope of work. This log will help track the status of all materials that could be important to the overall project schedule. This log will show the suppliers’ company name, the p.o.#, the date of release, the material need date, the lead time, and finally the scheduled delivery date to the site. The Buyout Log is to be submitted to the Program Manager for review and approval no later than fifteen (15) calendar days after the Contractor(s) receive a notice to proceed from the owner. The Program Manager shall review within five (5) calendar days and return for modification or record. Any changes needed shall be made and a final
version sent by the Contractor to the Program Manager for final approval within five (5) calendar days from receipt. The information provided shall be used to establish the submittal schedule for the project.

b. Daily Work Force Form: This is a form that will be used to track the forces of any particular Contractor on a daily basis. This form is to be submitted to the Program Manager at the end of each work week.

c. Subcontractor/Vendor List: This is to be submitted to the Program Manager/Contract Manager for review prior to the awarding of the Contract.

d. Other lists & logs as required to monitor project status: During the progress of the project, other logs or lists may be needed to track the status of the project. The Program Manager/Contract Manager reserves the right to request additional information as needed.

3. TEMPORARY POWER: The Owner shall pay for temporary power consumption for construction. The cost of providing service (pole, meter, etc.) will be the responsibility of the Contractor for the Electrical Package. Temporary power shall be provided at convenient locations for the Lair building, Safari Café and Shift Yard, of adequate size and service to power all construction equipment, including but not limited to masonry saws, etc. Separate contractors are responsible to provide and pay for their job trailer power.

4. TEMPORARY WATER: The Owner shall pay for temporary water consumption. The cost of providing temporary water service required for construction is the responsibility of the Contractor for the Site General Trades. (Package 1). Temporary water sources shall be provided at the Lair building, Safari Café and Shift Yard. Separate contractors are responsible to provide and pay for their job trailer water and sewer.

5. SCHEDULE REQUIREMENTS:
   a. Within 15 days of the issuance of the Intent to Award the Prime Contractors shall submit a detailed Critical Path Method schedule in SureTrack electronic format and hard copy indicating how the contractor will meet critical milestones. This schedule shall include activities, activity durations, manpower/crew size, material lead time, and key predecessors for each activity. The Program Manager's review of the Contractor's construction schedule shall be only for compliance with the specified format, Contract Time, milestones, and suitability for monitoring progress of the Work and shall not be construed as a representation that the Program Manager has analyzed the schedule to form opinions of sequences or durations of time represented in the schedule.

   b. Format: The construction schedules shall be a detailed Critical Path Method schedule with both tabular and graphic activity information shown side-by-side. Contractor shall show all activities necessary for the completion of the project broken down by building, area, floor, and trade. Schedule shall graphically indicate both activity bars and target bars for all activities. Indicate the following.

   c. When revisions are made, distribute updated schedules to the same parties and post in the same locations.
d. These schedule requirements are in conjunction with Article 3.10.1 of the AIA A201/CMa.- 1992.

6. TEMPORARY TOILETS: The Building General Trades Contractor (Package 2) shall provide and maintain temporary toilets during construction as required for all work forces on the project regardless of work package.

END OF SECTION
Thank you for your work in making the Birmingham Zoo one of the finest zoos in the United States!

While working at the Zoo, you represent not only your company, but the Zoo as well. If your work takes you into the public sector of the Zoo, you will come in contact with the Zoo visitors, who are our valued guests, and to whom you will need to be courteous and respectful at all times.

The Birmingham Zoo’s management is your ultimate client, meaning that you may be given direction by a member of the Zoo’s management team that must be cooperatively and explicitly followed. Zoo management may need to direct contractor activities by either personal direction to your staff on grounds, or communication through the general contractor or Program manager, especially regarding activities that may interfere with operation of the Zoo, welfare of visitors or Zoo animals. Should this communication take place, it is to be understood that there is to be no argument with Zoo management. Uncooperative contractors may be dropped from the project, or contracted employees prohibited from continuing work on Zoo property, at no penalty to the Zoo.

**You and Your Work Site:**

**Work Hours:** The Zoo opens daily at 9 a.m. and remains open until 5 p.m. with extended summer hours of 9 a.m. to 7 p.m. on Tuesdays, Fridays, Saturdays and Sundays from Memorial Day weekend to the start of school in August. Early or late arrival times must be arranged through Zoo Management or the Program Manager. If your work is in the public area, please schedule it prior to or after public hours so to use the public areas as little as possible. If work is to continue beyond zoo closing, permission must be granted by Zoo Management in advance due to the requirements of some animals, that may be affected by noise or other distraction in the evening.

**Accessing Your Work Site:** All contractors MUST enter the worksite ONLY at the Construction Entrance. Should it become necessary to enter the Zoo at another entrance, you MUST get approval in advance from Zoo Management or the Program Manager for each specific entry. Please inform the Program Manager or Zoo Manager of your schedule and your needs to enter or exit the Zoo grounds so gates can be opened and closed for you. Also inform the Program Manager or Zoo Manager of your work site and route to and from that area. All personal vehicles must be parked in the assigned parking area for contract employees. Only official vehicles with permission may access the Zoo grounds. No one is to drive or park on any visitor walkways or in visitor areas within the Zoo.

**Your Work Area:**

- Please keep your work area clean. This includes not throwing trash on the ground or leaving trash on the ground at the end of the work day.
- Please keep your work area safe. This includes the retrieval of all nails and sharp objects that are on the ground. Magnetic rollers may be required to assist in this effort. Nails left on the work site area can become serious health issues for the animals.
- Keep all dangerous tools and materials away from Zoo visitors. Never leave your tools or equipment unattended if they are within reach of the general public. Over half of our visitors are little children who are very curious and many times not constantly or closely attended.
- You are responsible for securing your work area. Please make barrier arrangements with your contact person if a barrier is not already provided.

**Animal Safety Policy:** It is forbidden for anyone other than zookeepers to touch, feed or in any way interact with the zoo animals. Also, workers are not to enter into any animal service area without notifying zoo personnel. Please be aware of all public safety signage and stay in front of all animal barriers. Be sure to notify Zoo staff when working near animal areas.

**You and the Zoo:**

**Proper Uniform:** All construction employees need to wear their ID badge and hard hat at all times while on the work site.
**Harassment of the Zoo Visitor:** The Zoo Management has “zero-tolerance” for any form of harassment of Zoo guests and/or employees. Remember, you represent both the Zoo and your company, and you are expected to conduct yourself with decorum. Harassment includes, but is not limited to:

- Whistling,
- Foul or obscene language,
- Leering, staring, stalking, or touching.

**Communicating with the Zoo Visitors:** Normally your work should not put you in contact with Zoo visitors. However, if you are approached by a visitor, please refer them to the Zoo Office for any information they need.

**Zoo Policies You Need to be Aware of:**

**Smoking:** The Zoo is a smoke free facility. Smoking is allowed only in designated areas.

**Alcohol, Drugs and Weapons:** The Zoo has “zero-tolerance” for any use of, or possession of, alcohol or drugs on the Zoo grounds. Nor will it tolerate the possession of firearms, weapons or big sticks on the Zoo grounds.

**Use of the Zoo** Unless instructed otherwise, contract workers must stay within their work area at all times, including while on their break. This would include all zoo dining area, retail locations, restroom facilities, animal exhibits etc. Bathroom facilities will be provided within your work area.

**First Aid:** First aid needs are provided by the general contractor. Zoo staff must be made aware if 911 is called so that they can assist in directing EMS to the scene.*

**Animal Escape Procedure:** Animal escapes, while unlikely, is a possibility within the zoo. The zoo has emergency procedures to address such a situation. Contractor on site management will be instructed by the zoo staff of these procedure so that they can train the work force on what to do if such an event occurs.*

**Undesirable Visitor Behavior:** If you observe undesirable behavior by a Zoo visitor, contact your supervisor. Undesirable behavior would include, but not be limited to, teasing the animals, throwing objects into the animal areas, harassing other Zoo visitors, etc.

**Severe Weather:** In the event of approaching severe weather, you will be informed by zoo staff.*

*Construction management will be required to carry a radio for zoo communication purposes.
PART ONE - GENERAL

1.00 RELATED DOCUMENTS

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

1.01 EXTENT OF WORK

SCOPE: The project includes transforming 14.5 acres in the south-east quadrant of the Zoo into an immersive experience of the African Savanna. The project includes all new exhibits, animal holding facilities, and visitor amenities. The anchor of the project is a 3.35 acre habitat that will display elephants, rhinos, giraffe, zebra, and other African hoofstock. There is a small 6,700 SF habitat called the “Boma Yard” for elephant and rhinos which will reflect the experience of a rural African village. The project includes a new restaurant, dining pavilion, and restroom complex at the site of the existing Safari Café. This area will look and feel like a safari camp with the use of indigenous African materials including thatch, wood timbers, and stucco. The Café building is +/- 2,500 SF and includes a public servery and kitchen. The dining pavilion is a large thatch structure, typical of African lodges, and is +/- 2,800 SF. The restrooms are +/- 1,000 SF and will serve both the Café and the general zoo visitors. This project is the first in the country to be designed to accommodate an all bull herd of elephants. The Zoo plans to house 4 to 6 elephants in a new +/- 9,400 SF Elephant Holding Building (LAIR) and outdoor yards located adjacent to the existing Pachyderm Building. This building will be cast-in-place concrete and cmu. The Filtration or LSS building is +/- 1,600 SF and is located adjacent to the LAIR. This is an open-air structure that will house the recirculating and filtering equipment for the pools in the exhibit. The work is further defined and identified in the separate work packages attached to this section which are as follows: Site Plumbing and Site Sanitary Sewer, General Trades, Life Support, Electrical, Plumbing, HVAC, Rockwork, and Landscape.

1.02 CONTRACT WORK

A. The Contract Work shall include all labor, materials and equipment necessary to complete all work as described in Extent of Work and herein specified.

B. Drawings and Specifications are complementary, Divisions and Sections are arranged according to materials and functions and are not intended to be “trade” sections. These specifications establish construction and material standards as well as techniques and do not necessarily cover all specific items of materials shown on the drawings.

C. The contractor shall examine the premises and satisfy himself as to the existing conditions under which he will be obliged to operate in performing his part of the work under the contract. No allowance will be made subsequently in this connection in behalf of the Contractor for any error or negligence on his part.

1.03 SAFETY AND HEALTH REGULATIONS

A. Full compliance is required to the Department of Labor, Bureau of Labor Standards, “Safety and Health Regulations for Construction”, as published in the Federal Register, Volume 36, Number 75, dated Saturday, April 17, 1971, as may be applicable to this, or any later revisions.
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1.04 PROJECT INFORMATION

A. Project Identification: Trails of Africa CLR Project #06673
   a. Project Location: Birmingham Zoo, 2630 Cahaba Road, Birmingham, AL 35223-1106

B. Owner: Birmingham Zoo, Inc.
   a. Owner's Representative: Dan Trausch, Director of Operations, Birmingham Zoo. Phone: (205) 879-0409 x 204

1.05 EXAMINATION SURFACES AND/OR CONDITIONS

A. All Contractors shall examine all surfaces on which, or against which, their work is to be applied and shall notify the Program Manager and Architect in writing of any defects that they may discover which, in their opinion, would be detrimental to the proper installation or operation of their products. Commencing of work by Contractor denotes acceptance by Contractor of all surfaces and conditions affecting his work.

PROJECT BID PACKAGES

PACKAGE 1 – SITE GENERAL TRADES

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Provide all traffic control necessary to manage equipment and material entering and exiting the site. Additionally, provide necessary security precautions to avoid damage/injury related to the operation of the Owner's railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Perform periodic and final cleanup associated with this work, including removal of debris from the site.
7. All fences are to remain closed when not in use.
8. Coordination and cooperation with Owner's testing agent(s).
9. Certified As-Built survey of the work associated with this package.
10. Locating and avoiding underground utilities as related to this portion of the Work.
11. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
12. Unloading, storage and continued protection of materials and equipment for this Work.
13. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
14. Mobilization including remobilizations as required for the performance of this package.
15. Provide all trenching and backfilling related to the work of this package, and Package 8 – Rockwork.
16. Provide all pipes, fittings, clean outs, valves, etc. for the site plumbing system. This work is to terminate 5'-0" from the point where the service enters the building.
17. Provide all pipes, fittings, clean outs, valves, etc. for the site sanitary sewer system. This work is to terminate 5'-0" from the point where the service enters the building.
18. Provide all pipes, fittings, clean outs, valves, manholes, inlet grates, etc. for the site storm sewer system. This work is to terminate 5'-0" from the point where the storm system interfaces with the building storm system.

19. Provide tie-in of water mains including water meters.

20. Provide tie-in of site sanitary sewer to sewer mains.

21. Provide sub-meters for water main laterals to measure flow of water to yard hydrants.

22. Provide all back-flow preventers.

23. Provide chlorination of pipes and related testing.

24. Provide temporary water service for the entire project. This package is responsible for tapping main service lines, all costs and work associated with the tap, cutting and patching, piping from connection to distribution points on site. This package shall remove the temporary water service and perform all required patching at project completion. The Owner shall pay monthly consumption charges.

25. Provide install and connect water to construction manager’s job trailer, including removal of service at conclusion of the project.

26. Provide all site grading to +/- 1/10" of final grade at site, sidewalks, walkways, buildings, site walls, pools, mudbanks, and elsewhere as required.

27. Provide and install erosion control measures as required to prevent silting of storm lines and structures during the performance of the work of this Package.

28. Perform clean-out of all storm lines and structures at completion of the work of this Package.

29. Prepare sub-grades for slabs-on-grade.

30. Perform excavation and backfill necessary to complete building pads.

31. Perform excavating and backfilling of trenches for utilities and pits for buried utility structures installed by this Package.

32. Provide and install all geotextile fabric where indicated for earthwork performed by this Package and for Package No. 8 Rockwork.

33. Provide, install, and perform excavation (including support and protection if determined to be necessary) for the performance of work in this Package and Package No. 8 Rockwork.

34. Engage qualified land surveyor or professional engineer to perform surveys, layouts, and measurements as specified.

35. Provide temporary barricades and enclosures as required to protect the public and secure the site during and after Zoo hours.


37. Provide soil erosion control measures including installation, maintenance, and removal at demobilization. Any and all fines incurred by the Owner as a result of inadequate soil erosion control is the responsibility of this contractor.

38. Provide, install and maintain all temporary access roads for all contractors for the entire project site. Remove temp access roads at project completion. Provide an area of approximately 30,000 square feet of 4" GVA parking for the project.

39. Provide and install all permanent asphalt access roadways including any curb work. Maintain asphalt roadways during construction and patch/repair as required prior to turn-over to Owner at completion.

40. Removal and replacement of light gage train track as required for installation of a portion of the Work.

41. Provide, install and maintain all construction fencing at the limits of construction. Provide access gates for workers and vehicles at locations approved by the Owner. Note that the Owner’s existing exclusion fence along the southern perimeter of the site adjacent to Hermosa Drive is to be used as construction fencing during the project.

42. Provide and maintain wash down areas, construction entrances and temporary sediment traps at construction entrances/exits to assure public streets remain clean from jobsite soil, mud and debris. Periodically clean public roads surrounding construction site and final clean them before Final Inspection.

43. Provide and install permanent electric sliding gate with electronic controls at construction entrance. Gate is to be fully refurbished and codes are to be changed at substantial completion.
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44. Provide and maintain temporary barricades and enclosures for the performance of this work.
45. Provide and maintain construction entrances, exits and temporary access roads on site and around the buildings as required for construction.
46. Provide and maintain directional signage for control of pedestrian traffic.
47. Demolition of existing buildings, site features, utilities, etc. as described in the construction documents.
48. Provide perform, and install protection of existing vegetation to remain, removing existing vegetation, clearing and grubbing, stripping and stockpiling of topsoil, removing above and below grade improvements, disconnecting, capping, sealing, removing site utilities, temporary erosion and sedimentation control measures.
49. Provide and install irrigation sleeves. Locations to be coordinated with the work of Package No. 9 Landscape and Irrigation.
50. Perform excavation, slope stabilization, infill, backfill aggregate, sand, geotech fabric, etc. for exhibit work included in Package No. 8 Rockwork.
51. Arrange and pay for delivery and set-up of Program Manager's trailer from a storage site located in Bessemer, Alabama. This includes 4'-0" x 4'-0" wooden porch and any required steps and handrails. Arrange and pay for demobilization and return to storage site located in Bessemer, Alabama.
52. Provide, install and maintain service for holding tank for Program Manager's trailer.
53. Provide, install, maintain and remove temporary tree protection as shown on ST103.
54. Provide dewatering and drainage diversion as required.
55. Provide cut and fill and all grading.
56. Provide compaction at buildings, sidewalks, walkways, pools, mudbanks, and elsewhere as required.
57. Redress subgrade at all walks and site paving prior to installation of walks and paving.
58. Provide all asphalt paving.
59. Provide tree removal. This contractor is to participate in a pre-removal survey with the Owner to identify and confirm all trees to be removed.
60. Backfill at all curbs and site walls.
61. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense).
62. Each package is responsible for hoisting of their material and equipment.
63. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 2 - BUILDING GENERAL TRADES

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner's railroad.
5. Engineering, layout and staking for this Work.
6. Locating and avoiding underground utilities.
7. Unloading, storage and continued protection of materials and equipment for this Work.
8. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
10. Provide miscellaneous dewatering and drainage as required for the performance of this package.
11. Power, water and other utilities required for job trailer for this Package is the responsibility of this contractor.
12. Provide, install and maintain portable toilets to be used by all contractors.
13. Provide and maintain dumpster(s) for the work of all Packages during all phases of the Work.
14. Periodic and final clean-up associated with this Work, including removal of debris from the site.
15. Unload material pre-purchased by the Owner.
16. Coordination and cooperation with Owner’s testing agency(s).
17. All fences to remain closed when not in use.
18. The contractor shall perform general clean-up of and “policing” of the entire jobsite once a week including removal of debris from job site.
19. Provide excavation for foundations.
20. Provide and install drainage course for concrete slabs-on-grade.
21. Provide and install all termite control measures.
22. Provide and maintain OSHA compliant temporary stairs and/or ladders for access to all areas of the project site by all contractors until permanent stairs are installed.
23. Provide and install all anchor bolts and anchor rods, form facing materials, formwork shoring, re-shoring, reinforcement, reinforcement accessories, concrete materials, admixtures, water-stops, vapor retarders, floor and slab treatments, curing materials, related materials, repair materials and concrete mixture for all areas of the project with the exception of Package No. 6 Rockwork.
24. Provide and install all structural steel framing including structural steel materials, grout, base plates, grout at base plates, anchor bolts, bolts, connectors, anchor rods, threaded rods, primer, galvanizing repair paint, prime and/or re-prime field connections and welds and rust spots and abraded surfaces as specified. Include all hoisting, erection, layout, welding, and connection of structural steel framing.
25. Provide and install all steel decking including roof deck and accessories. Include all hoisting, erection, layout, welding, and connection of steel decking.
26. Provide and install all brick relief shelf angles and related embeds.
27. Provide and install structure, anchor channels, and trolley beam for animal lift crane.
28. Grates and angles for sump pits.
29. Provide fasteners for miscellaneous rough carpentry installed by this Package.
30. Provide and install all wood blocking required by work in this Package.
31. Provide and install miscellaneous rough blocking including rooftop equipment bases and support curbs, and cants, and crickets.
32. Provide and install all sheathing including wall sheathing, roof sheathing, composite nail base insulated roof sheathing, sheathing joint-and-penetration treatment, flexible flashing at openings in sheathing, fasteners, and miscellaneous materials.
33. Provide and install all gutters, downspouts, downspout boots, and related accessories.
34. Provide and install all membrane roofing systems including cap, base sheets, piles, roof insulation, cover board, auxiliary roofing membrane materials, insulation materials, and insulation accessories.
35. Provide and install all metal roofing panels and accessories including all copings, underlayment materials, and miscellaneous materials.
36. Package No. 4 Electrical will provide all boots or flashings for lightening protection systems for installation by Package No. 1 General Trades.
37. Provide two full Final Cleanings. One prior to substantial completion inspection and the second after the punch list is complete.
38. Provide, install, and maintain temporary partitions as needed for safety and privacy. This includes partitions for dust containment.
39. Provide and install temporary fire extinguishers across the project during construction to meet OSHA requirements.
40. Provide and install all steps, ramps, ladders, and stairs.
41. Finish exposed surfaces of concrete placed by this Package as specified.
42. Provide and install metal fabrications including steel framing and supports for overhead doors, metal bollards, removable bollards, pipe guards, abrasive metal nosings, fasteners, and miscellaneous materials.
43. Provide and install interior bollards at Elephant building as indicated.
44. Provide and install all pre-engineered metal stairs and railings. Provide and install all related connections and accessories.
45. Caging, gating, chutes, bollards, and fencing associated with the Elephant Building (interior to the LAIR, and exterior at the Herd Yard) are part of this package. For the LAIR building, and provide all concrete filled galvanized steel posts, footings, and accessories for the Elephant Bollard Barrier System detailed in the construction documents and provide all steel posts, pickets, top and bottom rails, footings, and accessories for the Rigid Outdoor Barrier System as detailed in the construction documents.
46. Interior and exterior Transfer Door and Gate Assemblies are part of this package. Provide and install all metal, accessories, footings, gates, and hardware for all interior and exterior animal access control systems on the project.
47. Provide and install Elephant Restraining Device (ERD) at the interior of the LAIR.
48. Provide and install in-slab scale at interior of LAIR.
49. Provide and install all interior finishes.
50. Provide and install all exterior building finishes.
51. Provide and install sand substrate at the outside elephant herd yard.
52. Provide and install backer rod and joint sealants at the interior of the building. Interior joint sealers include control and expansion joints on exposed interior surfaces of exterior walls, perimeter joints of exterior openings, vertical joints on exposed surfaces of interior unit masonry, perimeter joints between interior wall surfaces and frames of interior doors, and joints between fixtures and adjoining walls and floors and counters, joints at the top and bottom of partition walls, at door frames, at in-wall electrical boxes, and at dissimilar materials.
53. Provide and install all hollow metal doors and frames including frame anchors, stops, moldings and accessories.
54. Provide and install all overhead coiling doors.
55. Provide and install all hatches and access doors.
56. Provide and install all doors, frames, and hardware.
57. Provide and install all aluminum-framed entrances and storefronts including interior storefront framing, interior manual and automatic swing doors, glazing systems, entrance door systems, and accessory materials.
58. Provide and install all temporary construction cores and keys for all doors. Construction core keying shall be uniform across the project.
59. Provide and install all glass and glazing.
60. Perform final cleaning of all glazing throughout the project.
61. Provide and install all mirrors and toilet accessories.
62. Provide and install all non-structural metal framing including interior framing systems including supports for partition walls, framed soffits, bulkheads, furring, interior suspension systems including supports for ceilings and suspended soffits, suspension system components, steel framing for framed assemblies, and auxiliary materials.
63. Provide and install wood/metal blocking as indicated for casework, millwork, shelving, plumbing fixtures, toilet accessories, toilet partitions, interior door frames, interior door hardware, marker boards, wall mounted handrails, fire extinguisher cabinets, fire hose cabinets, interior windows, lavatory countertops, interior storefront, etc. Coordinate with other Packages as necessary for sizes and locations. If blocking is not indicated on the drawings, but is required for thorough installation, the blocking is to be provided.
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64. Provide and install all tiling including ceramic tile, porcelain tile, stone thresholds, crack isolation membrane, setting materials, grout materials, elastomeric sealants, and miscellaneous materials.
65. Provide and install all toilet compartments and accessories.
66. Foundation drain systems and waterproofing. Connect foundation drainings to storm sewer system.
67. Provide and install trench drains and slot drains.
68. Provide and install all sealed concrete, stained concrete, masonry coatings, and special concrete treatments as described in the construction documents related to the work of this package.
69. Provide and install concrete housing pads for Life Support & Filtration system, Mechanical, Plumbing and Electrical Packages.
70. Certified As-Built survey of building location, elevations of footing bottoms and floor levels.
71. Project sign as describe in the specifications.
72. All building specialty items.
73. Seal all penetrations in fire rated walls and assemblies.
74. All Health Department requirements.
75. Touch up galvanizing on metal after installation.
76. Backfill all building walls and foundations.
77. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense).
78. Each package is responsible for hoisting of their material and equipment.
79. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 3 - LIFE SUPPORT & FILTRATION

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner's railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Unloading, storage and continued protection of materials and equipment for this Work.
8. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor's workers, tools, materials and equipment on (and to and from) the jobsite.
10. Trenching and backfilling for pipe runs related to this portion of the Work.
11. Purchase and installation of Life Support & Filtration equipment. The Filtration Building will be provided under Package 2 above. Coordination with the Building General Trades contractor is required.
12. Testing, balancing and start-up of Work related to this section.

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14. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense).
15. Each package is responsible for hoisting of their material and equipment.
16. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
17. All low voltage control wiring associated with equipment provided by this Package shall be provided as part of this package.
18. Provide and install all required pipe supports.
19. Provide and install grout as required.
20. Provide and install flanges inset in concrete.
21. Perform full commissioning of the system and provide on-site training of Owner's personnel in the operation of all Life Support System and Filtration equipment.
22. Provide and install all pumps, filters and screens.
23. Provide and install all FRP grating
24. Provide and install all adjustable weir plates at skimmers (refer to sheet LS806).
25. Seal all pipe penetrations through concrete walls.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

**PACKAGE 4 - ELECTRICAL**

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. In delivering the work of this package, provide all necessary security precautions to avoid damage/injury related to the operation of the Owner's railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Unloading, storage and continued protection of materials and equipment for this Work.
8. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor's workers, tools, materials and equipment on (and to and from) the jobsite.
10. As-built survey, warranty/guarantee, owner's operation manual, and other documents required for project close-out.
11. Provide temporary power and lighting as required for the construction of this project including service required for such equipment as cranes, masonry saws, etc. Contractor is responsible for removing, repairing and restoring modifications at areas where off-site temporary power connections are made.
12. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense)
13. Each package is responsible for hoisting of their material and equipment.
14. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
15. Perform all cutting, patching, and sealing for work performed by this package.
16. Provide and install all sleeves necessary for Electrical systems at cast-in-place concrete.
17. Provide and install waterproofing seals where piping penetrates waterproofed walls and/or exhibit features.
18. Provide and install and make final connections for power for overhead ventilation louvers. Louvers are to be provided and installed by the Building General Trade contractor.
19. Make final electrical connections for commercial kitchen appliances and equipment.
20. Provide and install conduit, wiring, connections and devices required for hydraulic door equipment.
22. Package No. 6 HVAC will provide disconnects, motors, and starters for installation by Package No. 3 Electrical.
23. All low voltage control wiring associated with equipment provided by this Package shall be provided as part of this package.
24. Provide and install all electrical provisions necessary for HVAC systems.
25. Provide and install all conduit, wiring, and fire alarm devices for interface with air distribution equipment provided and installed by Package No. 5 HVAC.
26. Provide and install duplex outlets and telecommunications conduit as required for telephone and data communication.
27. Provide temporary telephone and data service to construction manager’s job site trailer. This package shall also remove the temporary service and perform all required patching at project completion.
28. Provide and install conduit, wiring and connections required for installation of Owner’s exterior exhibit sound system. Speakers, microphones, controllers, etc. are to be provided and installed by the Owner.
29. Provide and install conduit, wiring and connections required for installation of Owner’s exterior security camera system. Cameras are to be provided and installed by the Owner.
30. For underground utilities that penetrate underground walls, provide expansion seals for installation by Package No. 2 Building General Trades.
31. Provide contractor directed commissioning for all Electrical systems provided and installed by this package.
32. Provide and install all grout related to Electrical work provided and installed by this package.
33. Provide and install all underground ducts including all trenching, excavation, concrete and backfill.
34. Provide all supporting devices for electrical systems installed by this package.
35. Provide and install all switchboards.
36. Provide and install all grounding and grounding systems.
37. Provide and install all lightning protection systems.
38. Provide and install all panel boards.
39. Provide and install all site electrical work.
40. Provide power to remote retail kiosks, “plug and play” locations, and vending kiosks.
41. All electrical systems complete.
42. Fire alarm systems complete.
43. All trenching, excavation, backfilling, and compaction associated with all underground electrical.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 5 - PLUMBING

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner’s railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
8. Unloading, storage and continued protection of materials and equipment for this Work.
9. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
11. Trenching and backfilling for pipe runs related to this portion of the Work.
13. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor’s expense).
14. Each package is responsible for hoisting of their material and equipment.
15. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
16. Provide water to remote retail kiosks and “plug and play” locations.
17. Perform all cutting, patching, and sealing for work performed by this package.
18. Provide and install all sleeves necessary for Plumbing systems at cast-in-place concrete.
19. Provide and install support framing for plumbing equipment, fixtures, etc.
20. Provide waterproofing seals where piping penetrates waterproofed concrete walls and/or exhibit features.
21. Make final plumbing connections for commercial kitchen equipment at the Safari Café.
22. Provide contractor directed commissioning for all plumbing and utility systems provided and installed by this package.
23. Connect facility water distribution piping to building plumbing systems.
24. Connect facility sanitary sewers to building plumbing systems.
25. Provide and install isolation for all piping installed by this package.
26. Provide and install all Building water systems excluding the work provided in Package No. 3 Life Support and Filtration.
27. Provide and install all plumbing fixtures including toilet fixtures, janitorial fixtures, and animal drinkers.
28. All low voltage control wiring associated with equipment provided by this Package shall be provided as part of this package.
29. Provide and install all natural gas piping inside the buildings and to a point 5'-0" outside the perimeter of the building. Natural gas service outside the building is to be performed by others.
30. All plumbing systems complete.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 6 - HVAC

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:
1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner’s railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
8. Unloading, storage and continued protection of materials and equipment for this Work.
9. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
11. All low voltage control wiring associated with equipment provided by this Package shall be provided as part of this package.
13. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor’s expense).
14. Each package is responsible for hoisting of their material and equipment.
15. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
16. Provide and install filter media at all return air grills for start-up of permanent HVAC systems. Provide temporary filters and replace as needed after start-up of permanent HVAC system during construction and prior to Owner’s occupancy.
17. All warranties for HVAC equipment are to begin at substantial completion.
18. Perform all cutting, patching and sealing for work performed by this package.
19. Provide louvers including bird screens and blank off panels for all exterior wall louvers.
20. Provide and install insulation for piping installed by this package.
21. Provide motors, starters, disconnects, and variable frequency drives for installation by Package No. 4 Electrical.
22. Provide and install all grout related to HVAC work provided and installed by this package.
23. Provide contractor directed commissioning for all HVAC systems provided and installed by this package.
24. Provide all testing, adjusting, and balancing of HVAC systems installed by this package.
25. Provide and install all piping, valves, and accessories for HVAC systems.
26. Provide and install all condensate drain piping.
27. Provide and install insulation for all HVAC systems, equipment, ductwork and piping installed by this Package.
28. Provide and install all HVAC systems and equipment including coils, terminal units, air valves, air handling units, heat recovery units, fan-coil units, pumps, electric radiant heaters, and gas radiant heaters.
29. Provide and install all raceway, low voltage wiring, and controls for HVAC equipment.
30. Provide and install all air distribution including sheet metal work general, sheet metal work accessories, factory-fabricated plenums, sound attenuators, flexible connections, access panels, access doors, pressure relief doors, flexible ductwork, hangers and supports, air measuring stations, backdraft dampers, fire dampers, smoke dampers, combination fire/smoke dampers, manual dampers, control dampers, grilles, registers diffusers, fans-general, utility sets, centrifugal fans, filters, engine exhaust systems, filter pressure gauges, and smoke detectors.
31. Package No. 4 Electrical will provide and install all conduit, wiring, and fire alarm devices for interface with air distribution equipment provided and installed by Package No. 6 HVAC.
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32. Filters shall be replaced as often as needed during construction for proper operation of the HVAC system. Final filters shall be installed immediately prior to substantial completion.
33. Perform all air distribution systems cleaning.
34. Provide and install automatic temperature controls.
35. Perform excavating and backfilling of trenches for utilities and pits for buried utility structures installed by this Package.
36. Provide Owner training on the operation and maintenance of HVAC equipment.
37. All HVAC systems complete.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 7 - COMBINING PACKAGE 5 (PLUMBING) AND PACKAGE 6 (HVAC)
Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. The scope of work is the combination of Package 5 - Plumbing and Package 6 - HVAC.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 8 – ROCKWORK
Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner’s railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
8. Unloading, storage and continued protection of materials and equipment for this Work.
9. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor's workers, tools, materials and equipment on (and to and from) the jobsite.
11. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense).
12. Each package is responsible for hoisting of their material and equipment.
13. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
14. Provide and install all reinforcement, structural concrete, gunite and related work associated with mudbanks, boulders, beaches, pools, skimmer boxes, etc. as detailed in the construction plan.
documents. Note: Excavation, slope stabilization, infill, backfill aggregate, sand, etc. for exhibit rockwork will be performed in Package No. 1 - Site General Trades.

15. Waterproofing of all shotcrete and gunite work.
16. Closely coordinate with all other trades and packages whose work penetrates or terminates at the face of or otherwise is integrated with the shotcrete to assure proper, fully functional and waterproofed openings. It will be the responsibility of the Rockwork package to assure all penetrations in shotcrete are waterproofed.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 9 - LANDSCAPE AND IRRIGATION

Furnish and install all material, equipment, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner's railroad.
5. Finish grading and seeding of all disturbed areas.
6. Engineering, layout and staking for this portion of the Work.
7. Locating and avoiding underground utilities as related to this portion of the Work.
8. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
9. Unloading, storage and continued protection of materials and equipment for this Work.
10. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
12. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor's expense).
13. Each package is responsible for hoisting of their material and equipment.
14. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
15. Provide and install plants of the species, variety and quantity described in the construction documents.
16. Provide mulch, bedding and accessories as required to provide a completed project that is both aesthetically pleasing and capable of supporting the vegetation during seasonal changes.
17. Provide an irrigation system capable of supporting the vegetation. Irrigation system to be delivered on a design/build basis. Note: Sleeving for irrigation is provided and installed as part of Package No. 1 - Site General Trades. Irrigation system to include all piping, heads, controllers, sensors, etc. It is the responsibility of Package No. 1 to field locate required sleeving.
18. Provide and install topsoil at all areas that are indicated to receive landscape vegetation. Reuse of stockpiled topsoil is permitted.
19. Provide 1 (one) year maintenance of all planted materials as part of this Package.
20. Finish grading and seeding.
21. Tree staking.
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22. Excavation for root balls.
23. Excavation, trenching and compaction for irrigation.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

PACKAGE 10 - SITE BARRIERS AND HARDSCAPE

Furnish and install all material, labor, taxes, insurance, permits, fees, licenses, and any other costs needed to complete the Work per the Contract Documents, including but not necessarily limited to:

1. Compliance with all governmental authorities.
2. Permits, fees, licenses, taxes and bonds.
3. Compliance with OSHA and all safety regulations.
4. Traffic control for equipment and material entering and exiting the site including all necessary security precautions to avoid damage/injury related to the operation of the Owner’s railroad.
5. Engineering, layout and staking for this portion of the Work.
6. Locating and avoiding underground utilities as related to this portion of the Work.
7. Removal and/or relocation of underground utilities as required for the performance of the work of this package.
8. Unloading, storage and continued protection of materials and equipment for this Work.
9. Contractor is responsible for the security of its workers, tools, materials, and equipment on (and to and from) the jobsite. Owner and Program Manager make no representation about the security of the jobsite and disclaim any and all responsibility for the security of Contractor’s workers, tools, materials and equipment on (and to and from) the jobsite.
11. Daily clean-up associated with the work of this package, including removal of debris to dumpsters. (Note: should the contractor fail to perform daily clean-up, the Owner and Program Manager have the authority to perform clean-up at the contractor’s expense).
12. Each package is responsible for hoisting of their material and equipment.
13. Each package is responsible for their own off-site storage of materials and equipment and transportation to the jobsite.
14. Provide and install all view rails, exclusion fencing, chain link fences and gates, and other work related to restriction of visitor’s access to exhibit and animal containment.
15. Exterior cable fencing is part of this package. Provide all concrete filled galvanized steel posts, footings, cable, and accessories for the Elephant Cable Barrier System detailed in the construction documents.
16. Relocate and reinstall the Owner’s existing working wall currently on site.
17. Provide and install all metal, accessories, footings, gates, and hardware for all exterior access control systems on the project. Types of fences include, but are not limited to, Boma Barrier, service fence and gates, kick rail, view rail, chainlink hoofstock fence with dig barrier, fixed knot tensile New Zealand fence, hoofstock gate, hoofstock swing gates, boma service gate, exclusion fence and gates, etc.
18. Provide and install all hardscaping and pathways, excluding asphalt roadways.
19. Procure and transport to the site natural boulders of a size and type indicated in the construction documents. Scope of the work to be coordinate with the Owner and Architect.
20. Provide miscellaneous dewatering and drainage as required for the performance of this package
21. Provide and install all exhibit deadfall (see 7/ST802).
22. Provide and install all site retaining walls.
23. For concrete paving, provide and install formwork, steel reinforcement, concrete materials, curing materials, related materials, and concrete mixtures as specified.
24. Saw cut existing paving and walks where tie-ins are necessary.
25. Provide all concrete walkways.
26. Provide all mulch walkways.
27. Confirm, verify and correct as required all compaction and subgrade elevations at sidewalks and concrete walkways.
29. Site walls.
30. Transfer yard concrete wall.
31. Miscellaneous and structural steel associated with the work of this package.
32. Touch up galvanizing on all metal after installation.

This scope is a general guideline. It is the responsibility of the Contractor to perform all work indicated by the Contract Documents, regardless of any exclusion from the list above. Please refer to the Contract Documents for inclusion of all other items not listed above pertaining to your scope of work.

END OF SECTION
SECTION 01040 - THE DRAWINGS & SPECIFICATIONS

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Summary.

B.  Intent of Drawings.

C.  The Specifications.

D.  References.

E.  Standard Abbreviations.

F.  Terminology and Definitions.

1.2  SUMMARY

A.  The Contractor shall provide all quantities, items, articles, materials, operations, or methods listed, mentioned, implied, scheduled, or specified, on the drawings, including all labor, materials, equipment and incidentals required for their completion.

B.  The drawings for this Project entitled, “Trails of Africa” dated 24 June 2009 with any revision dates shown in the title block, have been prepared by CLRdesign inc. (Architects, Exhibit Designers and Landscape Architects) CCI, CRS, MBA, & MWH (Civil, Mechanical, Electrical, Structural Plumbing, and Life Support Engineers)

1.3  INTENT OF DRAWINGS

A.  The implied intent of the drawings includes the overall layout of the project, inclusive of structures, site improvements, location of all items required during construction, the extent of construction, and the extent of the materials.

B.  The drawings are divided according to design discipline; however, all such drawings constitute the project as a whole, and are, as a result, directly related to one another.  The drawings are not divided into, or are intended to be divided into separate entities according to building trades, local practices or project bid packages.  It is the responsibility of the Contractor to share, exchange, acquire, & disseminate all information represented on the drawings so that all trades and sub-trades will have complete and thorough knowledge of the project intent.  No requests for Change Orders, time extension, or other considerations will be accepted if the Contractor fails to properly coordinate information to the various trades/sub-trades.  Items may, or may not be indicated on all the various design discipline drawings, however, what is indicated on one, design discipline drawing shall be considered indicated on all design discipline drawings.

1.4  THE SPECIFICATIONS

A.  Division of the specifications into sections is done for the convenience of reference and is not intended to control the Contractor in dividing the Work among subcontractors or to limit the scope of work performed by any trade under any section.

B.  Abbreviated references to trade associations, technical societies, recognized authorities and other institutions are included in the contract documents.  Any abbreviation or organization not recognized by the Contractors shall be requested from the Architect or Exhibit Designer for interpretation.  Failure to request and receive an interpretation shall not relieve the Contractor of...
performing and/or supplying materials or workmanship in compliance with specified references to the satisfaction of the Architect or Zoological Consultant.

1.5 REFERENCES

A. References to known standard specifications shall mean and intend the latest edition of such specifications adopted and published as of the date of the invitation for the bids.

1.6 TERMINOLOGY AND DEFINITIONS

A. Where words or terms are not defined here in this Section or elsewhere in these Specifications and/or Drawings, then final meanings shall be derived from Webster’s New Collegiate Dictionary, latest edition, published by G. & C. Merriam Co, Springfield, MA.

B. The following words are to be construed as having the meanings and definitions indicated.

1. Architect: Authorized representative of CLR design inc.
2. Exhibit Designer/Landscape Architect: Authorized representative of CLR design inc.
3. Approved/Approval: Accepted in writing by the Architect or Exhibit Designer.
4. As Selected: As selected by the Architect or Exhibit Designer.
5. If Requested: If requested by the Architect or Exhibit Designer.
6. Indicated: As shown on the drawings or referred to in the specifications.
7. Satisfactory: Acceptable in the judgement of the Architect or Exhibit Designer.
8. Where: Where or when practicable in the judgement of the Architect or Exhibit Designer.
9. As Required: As required by the Architect, Exhibit Designer, or as field conditions dictate.
10. Replace: To remove an existing product or service, and furnish and install an indicated product in it.
11. Provide: Means to furnish plus install the noted product or service.
12. Supply (v): Means to furnish plus install the noted product or service.
13. Specifications: The total and complete specification of this Project as identified by the Architect, the Exhibit Designer and Landscape Architect and the Architect’s Consultants, including referenced standard specifications, the General Specifications and the Technical Specifications as indexed.
14. System/Assembly: In the context of this Project, where a 'system' or an 'assembly' as indicated or identified in the Specifications and/or Drawings, it shall consist of the sum of all the relevant parts and/or materials specific to the use of the system or assembly indicated; installed complete, in place, and in working order. All said parts and/or materials required for a completed system indicated, shall be supplied and installed as part of the Base Bid Price for a complete, proper, and fully functional installation, whether specifically detailed or not; example - Fibar 300 'System' (Exterior Resilient Woodchip Surfacing): All materials required for a complete and proper installation shall include supplying and installing an underground perforated drainage pipe, drainage mat, and resilient woodchip surfacing. All materials for this system shall be installed completely, all necessary connections to other construction shall be provided. Upon completion of this system, the sum of all the parts that constitute the make-up of this system shall function and/or operate properly.
15. Mandatory: Means as required by code, any Building Authority, and any and all governing laws. All mandatory requirements for construction shall be included in the Base Bid price for the Project.
16. Functional: Item(s) installed that are to operate properly or as intended.
17. Typical: A condition, detail, or other item that is common to an identified system, assembly, or any other construction condition where the essential characteristics are the same.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   a. Coordination Drawings.
   b. Administrative and supervisory personnel.
   c. Project meetings.

1.3 DEFINITIONS

1. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

1. Coordination: Contractors to coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.
   a. Coordinate construction operations, included in different Sections, which depend on each other for proper installation, connection, and operation.

2. Contractors to prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

3. Administrative Procedures: Contractors to coordinate scheduling and timing of required administrative procedures related to their package of work with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   a. Preparation of Contractor's Construction Schedule.
   b. Preparation of the Schedule of Values.
   c. Preparation of the Submittal Schedule.
   d. Installation and removal of temporary facilities and controls.
   e. Delivery and processing of submittals.
   f. Progress meetings.
   g. Pre-installation conferences.
   h. Project closeout activities.
   i. Startup and adjustment of systems.
   j. Project closeout activities.
4. Conservation: Contractors are to coordinate construction activities in their package of work to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
   a. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to Owner for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

1. Coordination Drawings: Contractors are responsible for the coordination of all work related to their work package and are responsible for preparation of fully coordinated Coordination Drawings when required. Prepare Coordination Drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities. Provide coordination drawings for the integration of the work in a timely manner, allowing sufficient time for review by the Architect and Program Manager, so as not to delay the progress of work. Include information obtained by the Contractor during the course of construction, and detailed information contained in related shop drawings or product data.

2. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated.

3. Coordination drawings are considered shop drawings and must be definitive in nature. Refer to section 01300 – Submittals for requirements for submitting Coordination Drawings.

4. Submitted Coordination Drawings are for information only and typically will not be returned to Contractor. Architect and Program Manager will not take any action but may define coordination conflicts or problems and inform the Contractor of such conflicts or problems.
   a. Prepare and submit Coordination Drawings when required by other Sections.
   b. Content: Project-specific information is to be drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
      1) Prepare and submit coordinated composite layouts of the mechanical systems and equipment for all areas, drawn at a scale not less than 1/4” per foot showing on both plan and elevation, including, but not limited to, all equipment, ducts, pipe sleeves, piping including plumbing and sprinkler system, lighting, kitchen equipment, special supports and other items contained within the space and finished ceiling. Show mechanical and electrical services as well as architectural and structural features drawn to scale. Provide composite drawings for all areas such as corridors, specialty spaces, mechanical rooms, shafts, tunnels, and all congested areas. Distribute copies of composite drawings to all trades to assure a complete, coordinated installation of work within the space available. Include elevation drawings indicating finish ceiling heights, and heights above finished floor to bottom of ductwork, piping and conduit.
      2) Indicate functional and spatial interrelationships of components of architectural, structural, civil, mechanical, and electrical systems.
      3) Indicate required installation sequences.
      4) Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment.
and minimum clearance requirements. Provide alternate sketches to
Architect for resolution of such conflicts. Minor dimension changes and
difficult installations will not be considered changes to the Contract.
5) Call attention in advance to Architect of any dimensional or detail
information needed to complete the coordination drawings.
6) Refer to other portions of Contract Documents, for specific coordination
drawing requirements for mechanical and electrical installations.
7) Architect and Consultants will not provide CADD Background drawings for
use by Contractor.
8) The architect will not process individual trade shop drawings until such time
as the coordination drawings have been sufficiently completed and conflicts
resolved.

c. Sheet Size: At least 8-1/2 by 11 inches but no larger than 24 by 36 inches.
d. Refer to Section 01300 for submittal procedure.
e. Refer to individual Sections for Coordination Drawing requirements for Work in
those Sections.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

1. General: In addition to Project superintendent, provide other administrative and
supervisory personnel as required for proper performance of the Work.

1.7 PROJECT MEETINGS

1. General: Contractors are responsible for conducting Project Meetings as required to
adequately coordinate the construction activities contained within their package of work.
Schedule and conduct meetings and conferences at Project site, unless otherwise
indicated.
a. Attendees: Inform participants and others involved, and individuals whose
presence is required, of date and time of each meeting. Notify Program Manager,
of scheduled meeting dates and times.
b. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited
attendees.
c. Minutes: Record significant discussions and agreements achieved. Distribute the
meeting minutes to everyone concerned, including Owner, Program Manager, and
Architect, within three days of the meeting.

2. Preconstruction Conference: The Program Manager will schedule a preconstruction
conference before starting construction, at a time convenient to Owner, Contractors, and
Architect, but no later than 15 days after execution of the Agreement. Hold the
conference at Project site or another convenient location. Program Manager will conduct
the meeting to review responsibilities and personnel assignments.
a. Attendees: Representatives of the Owner, Architect, Program Manager, and
Contractor.
b. Agenda: Will be set by the Program Manager.
c. Minutes: Program Manager will record and distribute meeting minutes.

3. Pre-installation Conferences: Contractors shall conduct a pre-installation conference at
Project site before each construction activity that requires coordination with other
construction.
a. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Owner, and Program Manager of scheduled meeting dates. Every effort shall be made to schedule pre-installation conferences on the Architect’s regularly scheduled days for visiting the site.

b. Agenda: Notification of conference and agenda shall be distributed 10 days in advance of meeting date. Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

2) Options.
3) Related RFIs.
4) Related Change Orders.
5) Purchases.
6) Deliveries.
7) Submittals.
8) Review of mockups.
9) Possible conflicts.
10) Trade responsibilities.
11) Compatibility problems.
12) Time schedules.
13) Weather limitations.
14) Manufacturer’s written recommendations.
15) Warranty requirements.
16) Compatibility of materials.
17) Acceptability of substrates.
18) Temporary facilities and controls.
19) Space and access limitations.
20) Regulations of authorities having jurisdiction.
21) Testing and inspecting requirements.
22) Installation procedures.
23) Coordination with other work.
24) Required performance results.
25) Protection of adjacent work.
26) Protection of construction and personnel.

c. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

d. Reporting: Contractor shall record and distribute minutes of the meeting to each party present and to parties who should have been present within 48 hours of meeting.

e. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

4. Weekly Progress Meetings: Contractor shall meet with Program Manager weekly to update key project concerns and issues.

a. Attendees: Contractor and Program Manager. Architect and Owner and subcontractors are optional attendees, but may attend if needed.

b. Agenda: Review and correct or approve minutes of previous progress meeting. Report on outstanding issues from the previous progress meeting. Review other
items of significance that could affect progress. Include topics for discussion as appropriate to status of project.

c. Minutes: Program Manager will record and distribute the meeting minutes.
d. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. **Monthly O/A/CM/C Project Status Review Meeting:** The Program Manager will schedule monthly Project Status Review Meetings. Contractors shall provide comprehensive update on their portion of the work. This meeting will be held during the last week of each month. Each Contractor shall reserve one working day to attend this meeting.
   a. **Attendees:** Owner, Architect, Contractors and Program Manager.
   b. **Agenda:** Contractors shall provide comprehensive review of the status of the project, project documentation, finances, schedule, and any issues that could affect project time, cost, or quality.
   c. **Minutes:** Program Manager will record and distribute the meeting minutes.
   d. **Reporting:** Distribute minutes of the meeting to each party present and to parties who should have been present.

### 1.8 REQUESTS FOR INTERPRETATION (RFIs)

1. **Procedure:** Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
   a. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   b. Coordinate and submit RFIs to the Program Manager in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
   c. RFIs shall be routed through the Program Manager to the Architect. RFIs that are not routed through the Program Manager will not be reviewed by the Architect.
   d. Program Manager will create a master log of RFI's and single unified numbering system.

2. **Content of the RFI:** Include a detailed, legible description of item needing interpretation and the following:
   a. Project name.
   b. Date.
   c. Name of Contractor.
   d. Name of Architect.
   e. RFI number, numbered sequentially.
   f. Specification Section number and title and related paragraphs, as appropriate.
   g. Drawing number and detail references, as appropriate.
   h. Field dimensions and conditions, as appropriate.
   i. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   j. Contractor's signature.
   k. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
   1) Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
3. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
   a. Attachments shall be electronic files in Adobe Acrobat PDF format or in MS Word format. This shall be coordinated with the Program Manager and Architect.

4. Architect's Action: Architect will review each RFI, determine action required, and return it to the Program Manager for distribution to Contractor and Owner. Architect will prioritize responses to RFIs. Contractors shall allow sufficient time for adequate review of RFIs by the Program Manager and Architect and be submitted in a timely manner so as not to delay the progress of the work. Architect’s response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
   a. The following RFIs will be returned without action by the Program Manager:
      1) Requests for approval of submittals.
      2) Requests for approval of substitutions.
      3) Requests for coordination information already indicated in the Contract Documents.
      4) Requests for adjustments in the Contract Time or the Contract Sum.
      5) Requests for interpretation of Architect's actions on submittals.
      6) Incomplete RFIs or RFIs with numerous errors.
      7) Architect's action may include a request for additional information, in which case Architect's time for response will start again.
   b. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.
      1) If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Program Manager in writing within 10 days of receipt of the RFI response.

5. On receipt of Architect's action, Program Manager to update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

6. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Program Manager to maintain master log. Software log with not less than the following:
   a. Project name.
   b. Name and address of Contractor.
   c. Name and address of Architect.
   d. RFI number including RFIs that were dropped and not submitted.
   e. RFI description.
   f. Date the RFI was submitted.
   g. Date Architect’s response was received.
   h. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   i. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
01100 - PROJECT MANAGEMENT AND COORDINATION

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
PART ONE - GENERAL

1.00 RELATED DOCUMENTS

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

1.01 PRE-CONSTRUCTION CONFERENCE

A. Prior to beginning any Work on this project, a meeting shall be held with the Architect, Program Manager, Separate Contractors, and all major subcontractors. The meeting shall review the requirements as they relate to each party, outline the Work schedule, and method of approach, and bring attention to all specific job requirements.

B. In preparation for this session, the Contractor shall identify long lead items, submittal packages, delivery dates and time requirements for Work by subcontractors, and prepare a list of activities which will form the basis for development of the Overall Project Schedule (OPS).

1.02 JOB COORDINATION MEETINGS

A. During the course of construction, the Architect, Program Manager, the Foreman, Contractors and all the subcontractors shall hold regular meetings and such other meeting as requested by the City Architect's representative. Site meetings are to be held each week to coordinate between contractors, with monthly meetings held to update the Owner, Architect, and Contractors. Informal meetings will be held as required to coordinate day-to-day construction activities. These meetings shall be held at the building site, unless such is not practical, for the purpose of establishing the current status of the project and to coordinate the various parts of the Work so as to expedite the progress of the Work.

1.03 Pre-Installation Conferences

A. Conduct a pre-installation conference before each activity that requires coordination with other construction. The installer and representatives of manufacturers and fabricators involved in the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend. Advise the owner of scheduled meeting dates.

1. Review progress of other activities and preparations for the activity under consideration at each conference, including time schedules, manufacturer’s recommendations, weather limitations, substrate acceptability, compatibility problems and inspection and testing requirements.

2. Record significant discussions, agreements and disagreements of each conference, along with the approved schedule. Distribute the meeting record to everyone concerned, promptly, including the Owner.

3. Do not proceed if the conference cannot be successfully concluded. Initiate necessary actions to resolve impediments and reconvene the conference at the earliest feasible date.

B. Pre-installation conferences may coincide with progress meetings with advance notification of attendees.

1.04 OPERATIONS ORIENTATION MEETING

A. Conduct an operations orientation meeting on date of substantial completion to orient the staff to the location of and operations of all mechanical and electrical systems.
1. Attendees: The Owner, Program Manager, the Owner’s operations personnel, the contractor, the mechanical and electrical subcontractors of the project and others who are familiar with the installation and operations of the installed mechanical and electrical systems.

2. Agenda: Discuss the operations and maintenance of all mechanical and electrical systems incorporated into the project.

B. Turn over maintenance manuals and proposed maintenance and service schedules for all mechanical and electrical items and/or systems to be serviced during contractor warranty period of one year. Provide manufacturers recommended maintenance and service schedules for all items and systems after expiration of contractor warranty period.

C. Substantial completion will not be given by the Owner until the operations orientation meetings have been completed for all mechanical and electrical items and/or systems and maintenance manuals, record drawings, etc. have been turned over to the Owner.

1.05 CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

A. The Contractor and Program Manager shall meet monthly with the City’s Project Team (e.g., City Architect, Project Manager and Scheduling Consultant) to update the Overall Project Schedule which graphically details the Contractor’s plan to sequence the work. The Contractor’s representatives attending this meeting should include the Project Manager, Project Superintendent. The schedule shall be developed in a format as outlined in Supplemental General Conditions.

1.06 ESTIMATE FORM

A. The Contractor shall furnish, in a form satisfactory to the City Architect, (1) detailed estimate giving a complete breakdown of the contract price by the various subdivisions of Work required under the contract documents and two (2) periodic itemized estimates of Work done for the purpose of making partial payments thereon. The costs employed in making up any of these schedules will be used only for determining the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the contract price.
SECTION 01230 - ALTERNATES

PART 1  GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1. The cost for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ADD ALTERNATES

A. Alternate No. 1: Radiant floor heat in Elephant Holding Building

1. Description: Provide and install complete radiant floor heat system in rooms 203 and 206 including: all piping; 2” concrete topping slab; 2” thick Foamular 400 rigid insulation
under entirety of all concrete floor slabs with piping; all boilers, pumps, and controls. See drawings 2/A202, S201, M200.

2. Base Bid: Concrete floor assembly with no radiant heat.

B. Alternate No. 2: Shade canopies at Elephant Holding Building
1. Description: Provide and install metal canopies at south elevation of building. See drawing A201.
2. Base Bid: No canopies. (Note that roof to loading dock remains.)

C. Alternate No. 3: Electric radiant heaters at Café Seating Pavilion (Room 517) and West patio (Room 506)
1. Description: Provide and install electric radiant heaters. See drawings A503, M500, M501.
2. Base Bid: Provide conduit to locations indicated for future installation of radiant heaters.

D. Alternate No. 4: Solotube Skylights at Café and Restroom
2. Base Bid: No Solotube skylights.

E. Alternate No. 5: Solar hot water heater at Restroom
1. Description: Provide and install solar hot water heater system at Restroom including: rooftop collectors, storage tanks, and all associated wiring, piping, and controls. See drawings A502, P501, E501.
2. Base Bid: Provide tankless water heater system as documented.

F. Alternate No. 6: NOT USED

G. Alternate No. 7A: Stamped and Colored Concrete Paving at Café Dining Areas
1. Description: Provide and install stamped and colored concrete paving as indicated on drawings ST105 Site Reference Plan, ST106 Site Materials Plan, and specification section 02760.
2. Base Bid: Standard grey concrete with light broom finish, per details and specification section 02750.

H. Alternate No. 7B: Stamped and Colored Concrete Paving at Café Plaza
1. Description: Provide and install stamped and colored concrete paving as indicated on drawings ST105 Site Reference Plan, ST106 Site Materials Plan, and specification section 02760.
2. Base Bid: Standard grey concrete with light broom finish, per details and specification section 02750.

I. Alternate No. 8: Stamped and Colored Concrete Paving at Visitor Paths
1. Description: Provide and install stamped and colored concrete paving as indicated on drawings ST105 Site Reference Plan, ST106 Site Materials Plan, and specification section 02760.
2. Base Bid: Standard grey concrete with light broom finish, per details and specification section 02750.

J. Alternate No. 9: NOT USED

K. Alternate No. 10: Schedule 80 pipe at LSS systems
1. Description: Provide Schedule 80 pipe above grade in lieu of Schedule 40 pipe at LSS systems. See LSS drawings and Specification Section 15490.
2. Base Bid: Schedule 40 pipe above grade (all underground piping shall be schedule 80).

L. Alternate No. 11A: Event Yard Path Concrete Paving
1. **Description:** Provide and install concrete paving, standard grey with light broom finish, as indicated on drawings ST105 Site Reference Plan, ST106 Site Materials Plan, and specification section 02750.

2. **Base Bid:** No work in this area will be required. Existing grades, paving, landscape, and other conditions to remain undisturbed.

**M. Alternate No. 11B: Event Yard Path Stamped and Colored Concrete Paving**

1. **Description:** Provide and install stamped and colored concrete paving, as indicated on drawings ST105 Site Reference Plan, ST106 Site Materials Plan, and specification section 02760.

2. **Base Bid:** No work in this area will be required. Existing grades, paving, landscape, and other conditions to remain undisturbed.

**N. Alternate No. 12: Shade Structure at Elephant Yards**

1. **Description:** Provide shade structure including steel mast system, foundations and eyebolts, and shade cloth system. Shade cloth system to be provided by Cain Awning (205-323-8379) or approved equal. System to include Commercial 95 fabric, 10oz/sq. yard; heat sealed seams; perimeter reinforced with 2” seatbelt webbing or cable; heavy duty d-rings at attachment points, tensioned with galvanized turnbuckles. Color selected from manufacturer's standard range. See drawings 1/A202, S203.

2. **Base Bid:** No shade structure.

**O. Alternate No. 13: Sarnafil Roofing System**

1. **Description:** In lieu of TPO roof system specified in Section 07543 provide a PVC roof system by Sarnafil. Provide Décor battens and full choice of standard colors at sloped roofs.

2. **Base Bid:** Provide TPO roof system as specified in Section 07543.

**P. Alternate No. 14: Camera System**

1. **Description:** Provide and install Camera system by Advanced Integration Systems (205-545-3243) or approved equal. Provide full written description of system for approval by Owner prior to bid. Include all wire and wire pulls.

2. **Base Bid:** Provide and install all conduit.

**Q. Alternate No. 15: Audio Visual System**

1. **Description:** Provide and install Audio Visual system by Forsyth Consulting (205-879-2892) or approved equal. Provide full written description of system for approval by Owner prior to bid. Include all wire and wire pulls and shelving or racks.

2. **Base Bid:** Provide and install all conduit.

END OF SECTION
PART ONE - GENERAL

1.00 RELATED DOCUMENTS

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

1.01 IDENTIFICATION

A. Shop Drawings and samples shall be properly identified by project name, description or names of equipment, materials, and items and complete identification of location at which materials or equipment are to be installed.

1.02 SHOP DRAWINGS

A. Eight (8) sets of opaque reproductions shall be initially submitted by the Contractor directly to the Program Manager, for various areas of work as designated, with the Contractor's "review stamp" and corrections indicated on each set. The Program Manager will distribute Shop Drawings to Architect and Consultants. The Architect, and/or Consultant will review, make corrections (if required) and stamp and return to the Program Manager for distribution to the Contractor. Reproduction of construction document drawings, and/or details as substitutions for original submittal drawings will NOT be accepted.

B. In lieu of Shop Drawing prints, Contractor may at his option, submit three (3) reproducible prints of each drawing until final approval is obtained, at which time five (5) corrected copies shall be submitted.

C. All drawings which must be reviewed by Consultant Engineers will be submitted by the Program Manager directly to Engineer with one copy simultaneously to Architect.

D. Approval will be for general design only and will not relieve Contractor from responsibility for errors or omissions in Shop Drawings, even though same were not indicated when approved.

E. In checking Shop Drawings, Architect and Program Manager shall not be required to check dimensions, quantities, electrical characteristics, or specific capacities, these being the responsibility of the Contractor. Contractor shall attest, either in writing by stamp, or signature, that all Shop Drawings submitted for approval have been checked for compliance with the Drawings and Specifications prior to submission to the Program Manager; otherwise they will be returned unchecked.

F. Approval of Shop Drawings, shall be for general design only and will not relieve Contractor from responsibility for errors and omissions. Approvals shall not be construed as approved departure from Contract Drawings and Specifications.

G. No Shop Drawings shall be submitted directly to the Architect from a manufacturer, jobber, or subcontractor. All submittals shall be through the Contractor.

H. Electronic copies of “CAD drawings of the contract documents will not be provided by the architect for contractors use.

I. Present in a clear and thorough manner, with details identified by reference sheet, detail, schedule or room numbers shown on the Contract Drawings. Sheet size shall be no larger than the Contract Drawings and no smaller than 8-1/2" x 11".
J. Shop drawings which are indicated as "NOT APPROVED" by the Program Manager, Architect, or Consultants on the initial submission will have been rejected due to either lack of appropriate information or excessive errors in information. All unapproved shop drawings must be resubmitted by the Contractor to the Program Manager, Architect, and/or Consultant's approval is obtained.

K. No extension of time in the construction schedule will be allowed due to unapproved submissions.

1.03 SAMPLES

A. Furnish all samples called for in the detail Specifications and such other samples as the Architect may direct.

B. Samples for color selection shall include a complete selection of available colors and finishes. After Architect has selected colors and finishes, submit four (4) additional samples of the selected colors and finishes which will become a master color guide to be used throughout the progress of the Work.

C. All sample submissions shall be of the actual materials to be incorporated in the Work and shall be submitted in duplicate. One (1) APPROVED sample or set of samples shall be retained by the Architect and/or Consultant and the other sample or set of samples will be returned to the Contractor.

D. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1.04 SUBMISSION

A. Submission of Shop Drawings and samples shall be by a transmittal letter, in duplicate containing project name, Contractor's name, subcontractor's and/or vendor's name, a complete listing of Drawings and samples.

B. Samples of the selection of color and finishes shall be made in one submittal. No color selections will be made until samples on all items requiring the color selection have been submitted.

C. Transmit each item under AIA Form G810. Include the following:
   a. Submission date and dates of any previous submissions
   b. Architect's project title and number
   c. Names of Contractor, subcontractor, and major suppliers and manufacturers.
   d. Identification of product with specification number.
   e. Field dimensions clearly identified as such.
   f. Applicable standards, such as ASTM, Federal Spec numbers, and other standards.
   g. Identification of deviations from the Contract Documents.
   h. Identification of revisions on submittals.
   i. Space for Program Manager's, Architect's, and Engineer's stamps

D. Apply Contractor's stamp, signed or initialed certifying that review, 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.

E. Schedule submittals to expedite the Project and delivery to Program Manager. Coordinate the submission of related items.
SECTION 01300 - SUBMITTALS

F. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

G. Distribute copies of reviewed submittals to all concerned parties. Instruct parties to promptly report any inability to comply with provisions.

H. Do no fabrication or work which requires submittals until the return of submittals with the Architect's approval

I. Submittal review time is twenty-one (21) days total. Seven (7) days for review by Program Manager and fourteen (14) days for review by Architect and Consultants.

1.05 MANUFACTURER’S INSTRUCTIONS, PRODUCT LITERATURE, CERTIFICATES, AND REPORTS

A. All instructions, literature, certificates, test reports, other technical data and correspondence shall be submitted in four (4) copies. Two (2) copies shall be retained by the Architect and/or consultant and the other two (2) copies shall be returned to the Contractor.

1.06 WRITTEN CERTIFICATIONS

A. Provide written certifications where required in the following formats:

a. Manufacturers’ Written Certification: Shall be submitted in letter form on the manufacturer’s letterhead, signed by an authorized representative, indicating that all required components and elements of their manufacture are in conformity with the requirements so stated under the individual section of the Specifications. Technical data, additional support material, or other information may be submitted with the certification letter.

b. Installer’s Written Certification: Shall be submitted in letter form on the installer’s company letterhead, signed by a legally authorized company officer, indicating that their respective installation and/or Work are in conformity with the requirements so stated under the individual section of these Specifications.

END OF SECTION
SECTION 01400 - QUALITY CONTROL

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Quality assurance and control of installation.
B. References.
C. Field samples.
D. Mock-up.
E. Inspection and testing laboratory services (Owner selected, Owner paid).
F. Manufacturers' field services and reports.

1.2  QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
B. Comply fully 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 a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Perform work by persons qualified to produce workmanship of specified quality.
F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.3  REFERENCES

A. Conform to reference standard by date of issue.
B. Obtain copies of standards when required by Contract Documents.
D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.4  FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.
B. Acceptable samples represent a quality level for the Work.
1.5 MOCK-UP

A. Where mock-ups are specified under individual technical sections, construct a full scale, working prototype of items identified, either in place or in an independent location, as directed by the Architect.

B. Tests will be performed under provisions identified in this section.

C. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.

D. Accepted mock-ups shall remain in place and serve as a quality control for the duration of the project.

E. Mock-ups may remain in place as part of the Final Work, only if directed in writing by the Architect. Mock-ups that are not to remain as part of the Final Work shall be dismantled and removed off-site.

1.6 INSPECTION AND TESTING LABORATORY SERVICES

A. The Owner will select and pay for services of an independent firm to perform inspection and testing.

B. The independent firm will perform all necessary inspection, tests, or other services specified in the individual specification sections or as required by the Architect or Engineer.

C. Reports will be submitted by the independent firm to the Program Manager, Contractor, Owner, Architect, and appropriate Engineers, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
   1. Notify Architect, Owner and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm for additional samples and tests required for Contractor's use.

E. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect. The Contractor shall pay for all retesting required for non-compliant test results.

1.7 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturer's 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. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

C. Submit report in duplicate within 30 days of observation to Architect/Engineer for review.
PART ONE - GENERAL

1.00 RELATED DOCUMENTS

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

1.01 TEMPORARY OFFICES AND SHEDS

A. The Contractor shall provide his office, storage sheds and other structures as may be necessary to carry on the Work. All temporary facilities shall be immediately executed at the start of construction work and shall be maintained by the Contractor and comply with all of the latest and enforceable regulations until new systems are operational and the Owner has accepted the project, or designated portion(s) thereof, as substantially complete and assumed responsibility for all applicable succeeding utility charges.

B. Storage sheds shall be of sufficient size to store all materials required on the job site at any one time. Sheds shall be watertight and have floors above the ground.

C. Nothing in this section is intended to limit the types and amounts of temporary work required, and no omission from this section will be recognized as an indication by the Architect that such temporary activity is not required for successful completion of the work and compliance with requirements of the Contract Documents and governing authorities.

1.02 TEMPORARY LIGHT AND POWER

A. Temporary light and power service shall be furnished and installed by the Electrical Contractor and the owner shall pay for service.

B. Provide weather proof and grounded electrical power distribution sufficient to accommodate construction operations requiring power use of power tools, electrical heating, and lighting while maintaining safety for construction personnel and the public from injury due to electrical construction operations.

C. Sufficient temporary lighting to ensure lighting levels appropriate for proper workmanship shall be provided by combined use of daylight, general lighting, and portable task lighting.

1.03 TEMPORARY WATER CONNECTION

A. The Site Plumbing and Site Sanitary Sewer Contractor shall make connection and Owner shall furnish all water required in connection with this contract.

1.04 SECURITY

A. The Contractor shall protect all materials and construction as required. He will be held responsible and required to repair any damage or replace any loss which may occur during the period of the Contract to any part of the Work, materials, or equipment including items on site furnished by the Owner or others for the installation by the Contractor.
1.05 TELEPHONE
A. The Contractor shall (if he deems necessary) install at his own expense, a single party job telephone which shall be available for the use of all persons concerned with the construction of the project. All official long distance calls shall be paid for by the Contractor.

1.06 TOILET FACILITIES
A. The General Trades Contractor shall at the beginning of the work, provide on the premises toilet facilities and enclosures for the use of all workmen at all stages of the project. Facilities shall conform to the requirements of the City. Separate facilities for male and female personnel shall be provided when both sexes are working, in any capacity, at the project site.

B. Toilet facilities within the existing Zoo buildings shall not be used by construction personnel without permission from the Owner.

1.07 TEMPORARY HEAT
A. Each Contractor shall provide any temporary heat which may be required for protecting and drying out their portion of the Work and to enable their portion of the Work to be performed in cold weather.

B. Heat shall be provided by means of an approved temporary heating device which, in installation and operation, will not damage the finish in the building. As soon as temporary or permanent enclosure is complete for any area of construction, and temporary heat is required for scheduled work, or required to facilitate proper workmanship, and the permanent heating system is not yet operable or authorized for use, provide temporary heat service to do work at the project site. Maintain temperatures as indicated or required by other specification section for the proper drying, curing, and protection the work. Contractor must provide temporary heat and may not use any component of the permanent HVAC system during construction.

C. All costs in connection with the providing of temporary heat shall be borne by the Contractor.

1.08 PROTECTION
A. Provide and maintain all fences, planking, bridges, bracing, shoring, sheet piling, lights, barricades, warning signs, and guards as necessary for the protection of streets, sidewalks, landscaping, adjoining property and the streets adjacent.

B. Provide protection for all shrubs, trees, lawns, walks, roads, drives, adjacent building and equipment, both on and off property, and in roads and streets adjacent.

C. The General Trades Contractor shall provide temporary construction fencing to enclose material and construction operations and prevent public entry to the site during construction and protect existing facilities and adjacent properties from damage, and the general public from injury, by construction operations.

D. Provide construction fence around the designated portion of the project site, as indicated on the drawings and directed by the Owner. Equip fencing with not less than two (2) 3'-0" wide personnel gates and two (2) 12'-0" wide vehicular access gates in locations as required for construction personnel and vehicle passage. Gates shall be provided with locks for securing project site at end of each day's work. Personnel gate shall have 'panic hardware' installed and
functional at all times. Material and method of construction shall be so as to withstand daily
construction operations, be highly visible, and be maintained until construction has reached a
point where no hazard to persons or property is present. Coordinate exact locations of fencing
and gates with Owner prior to installations.

E. Refer to Drawing ST-100 for the location of the Construction Fencing in relation to the Project
Work Limits. The Contractor shall be responsible for providing additional fencing and/or other
protective devices when working outside the normal construction fence limits.

F. The Contractor shall maintain the integrity of the Zoo Perimeter Fence as required by the United
States Department of Agriculture regulations.

1.09 PARKING FOR CONSTRUCTION PERSONNEL

A. Parking for private vehicles of construction personnel shall not be allowed within the boundaries
of the project construction limits. No parking shall be allowed on any other private property
without the expressed written consent of the property Owner to the Contractor. Parking for
Construction personnel will be permitted in a designated lot. During the zoo’s off-season
(September through February) the overflow parking lot adjacent to the entry drive at Cahaba
road. During other months, parking will be permitted on the undeveloped lot to the west of the
zoo property. In both cases, it will be the general contractor’s responsibility to provide
transportation from the parking lot to the construction entrance on Hermosa Drive. All
construction traffic is confined to the entry off Hermosa Drive. No entry will be allowed through
public or off-exhibit zoo property.

1.10 REMOVAL

A. Temporary facilities shall be removed promptly as each becomes no longer required.

1.11 FIRST AID PROTECTION

A. The Contractor shall provide the following: First Aid Accident Cabinets at the job site.

1.12 FIRE PROTECTION DURING CONSTRUCTION

A. Emergency fire protection shall be provided, using extinguishers, said equipment conforming to
the requirements of the National Board of Fire Underwriters’ and relevant
Insurance Company. Particular care shall be exercised when using open flame and welding and
cutting equipment; use only flame proof type tarpaulins. Keep site clean and orderly with proper
protection of combustibles while in use and in storage.

1.12 Construction Badges

A. Each Contractor will provide badges for their staff. Badges are to be approximately 2 ½” x 4” and
will bear the Project Name (Trails of Africa) and the name of the Contractor’s company. Badges
are to be worn by construction staff at all times.
SECTION 01550 - ANIMAL MANAGEMENT REQUIREMENTS OF CONSTRUCTION

PART 1 GENERAL

1.1 SUMMARY

A. Animal Management requirements of construction are indicated at various areas of the Construction Documents. These requirements are general in nature and indicate universal-type details required to be constructed as part of the Base Contract Price for this Project. Inclusive of these requirements, the contractors, and all subcontractors shall, as part of the Base Contract Price, do the following:

1. Hide all conduit, pipes, water lines, cables, utility lines, etc., or other loose construction to avoid animal contact. Where this is not possible, the specified guard plates, or other protective devices shall be installed at no additional cost to the Base Contract Price.

2. Animals have been known to injure themselves due to items left in and around animal spaces. Each contractor shall be responsible for regularly inspecting and removing all construction debris in compliance with this requirement for work in his/her area including, but not limited to, nails, screws, wire, wood and metal scraps, welding rods, and other small fasteners or miscellaneous items. No hard or loose materials larger than ¼" in any dimension shall be left in any animal area and within 10’ of an animal barrier.

Upon completion of the Work and immediately prior to substantial completion, contractor shall sweep areas (including to 10’ beyond animal barriers) with sweep magnet and metal detector to clean site of metal debris. Contractor shall also complete a thorough visual inspection of the area.

Each contractor shall be responsible for compliance with these requirements for his/her Work, and shall be liable for repair or replacement of work (including display windows) damaged by an animal using objects left within its reach.

3. Provide the special animal management requirements of construction wherever required, as detailed on the Drawings, or written into these Specifications.

B. The intent of these requirements is to ensure that the Owner obtains a facility so that zoo personnel and animals may interact safely. These requirements are not intended to cover all conditions that may arise during construction and the Contractor shall cooperate with the Owner and Architect during construction.

C. The Contractors shall recognize that this facility is of unique construction and shall at all times take precautions to minimize the use of the Animal Management requirements as much as possible by thorough coordination of all the sub-trades involved and thorough coordination of placement of all Work prior to installation throughout the Project, to minimize contact with the animals.

PART 2 PRODUCTS

2.1 DETAILED PRODUCTS

A. Provide the materials indicated in the details and notes, where conditions require their respective use.
PART 3  EXECUTION

3.1  INSTALLATION

A. Install all required items and/or perform all required work to create uniform and consistent condition to the requirements of the Animal Management notes and details.

END OF SECTION
PART ONE - GENERAL

1.00 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to and form a part of this Section.

1.01 PRODUCTS AND MATERIALS
A. Products, materials and manufactured items or articles of like nature shall as nearly as possible, be of one brand or manufacturer. No changes or substitutions shall be made without written consent of the Architect.
B. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
C. Products Specified by Naming Three or More Manufacturers: Products of manufacturers named and meeting specifications no options or substitutions allowed.
D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
E. Products Specified as “Basis of Design”: Subject to compliance with requirements, provide the named product or comparable approved product.
F. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

1.02 MEASUREMENTS
A. Before ordering any materials or doing any Work, the Contractor shall verify all measurements of the building and shall be responsible for correctness of same. No extra charge or compensation will be allowed because of the differences between actual measurements and dimensions indicated on the Drawings. Any differences which may be found, shall be submitted to the Architect for consideration before proceeding with the work.

1.03 ASBESTOS MATERIALS
A. No asbestos materials or products containing asbestos shall be installed in the Project.
B. If any such material or product is inadvertently installed, it shall be removed and replaced with an approved substitute, at no cost to the Owner.
C. The Contractor shall provide a notarized certificate as required in Section 01700, that these conditions have been met.

1.04 USE OF FOREIGN MATERIALS
A. The Contractor shall agree to use in the execution of this Contract only materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if same are available at reasonable and competitive prices per the Supplemental
SECTION 01600 – MATERIALS AND EQUIPMENT

General Conditions 13.13.

1.05 STANDARD AND INDUSTRY SPECIFICATION

A. Any material or operation specified by reference to the published specification of a manufacturer, The American Society for Testing and Materials (ASTM), The American Standards Association (ASA), Federal Specifications, or other published standard shall comply with the requirements of the current specification or standard listed. Should there be a discrepancy between the referenced specification and the Contract Documents, the latter shall govern unless written interpretation is obtained from the Architect. Should there be discrepancies among the referenced specifications or standards, the more stringent requirements shall govern.

B. The Contractor shall, if requested, furnish an affidavit from the manufacturer certifying that the materials or products being furnished meet the requirements specified. Such certification, however, shall not relieve the Contractor from the responsibility of complying with other requirement of the Contract Documents.

1.06 MANUFACTURER’S DIRECTIONS

A. All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned according to manufacturer's directions unless herein specified to the contrary. Should there be a discrepancy between an installation as required by the Drawings and/or Specifications and the manufacturer's directions and/or recommendations, such discrepancy shall be brought to the attention of the Architect and shall be resolved before the work may proceed.

1.07 TRADE SECTIONS

A. Sections of this Specification are "all inclusive" in many areas. Certain products, materials, equipment and/or installation procedures may not apply to the specific work required even though included in the section. Where there is no indication in the Contract Documents of a specific item of work to be furnished or installed, the contractor shall confirm same with the Architect during bidding then ignore the items and not include them in his proposal or scope of work required.

1.08 STORAGE OF MATERIALS AND EQUIPMENT

A. Materials and equipment not stored on the site shall be stored in a bonded warehouse approved by the Architect.

B. All materials shall be stored so as to protect them from the elements and damage of any type including damage during transit.

C. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

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

E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

H. Protect all installations of products in situ prior to required inspections and final acceptance in a manner keeping with the items listed above.

1.09 TRADE NAMES

A. The use of manufacturers' names and serial numbers are given to establish a standard of manufacturer and not intended to be restrictive or preferential. Similar, equal and approved materials of other manufacturers will be acceptable, subject to the approval of the Architect, pursuant to the requirements as hereinafter set forth.

1.10 SUBSTITUTIONS

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

B. In the event architectural requirements of an “APPROVED” material is different from the specified and/or as indicated on the Drawings, any additional cost involved shall be the responsibility of the Bidder and his bid must include such cost. No extra cost to the Owner will be allowed because of the use of such materials.

C. A request constitutes a representation that the Bidder or Contractor:
   a. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   b. Will provide the same warranty for the Substitution as for the specified product.
   c. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to the Owner.
   d. Waives claims for additional costs or time extension, which may subsequently become apparent.

D. Substitutions will be considered when a specified named product cannot be obtained, due only when the specified product is no longer in production, or the manufacturer is no longer in business. No substitution will be considered solely for specified products that require long lead times. The contractor shall be fully responsible for obtaining products in a timely manner.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request or when acceptance will require revision to the Contract Documents.

F. Only one substitution will be considered for each product. When substitution is not accepted, provide the originally specified product.

G. If any additional design or engineering results from a Contractor substitution, then all fees for
these services shall be paid for by the Contractor

H. The Contractor, at his own expense, shall have any substitution material tested by an Owner/Architect approved testing agency, if deemed by the Architect to meet appropriate requirements.

I. No substitutions shall be installed in the Work prior to receiving review and approval by the Architect.

J. The specified Contract Completion Time shall not be extended by any circumstances developing from substitutions.

END OF SECTION
SECTION 01700 - PROJECT CLOSEOUT

PART ONE - GENERAL

1.00 RELATED DOCUMENTS

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

1.01 SCOPE

A. The Work under this Section consists of, but is not limited to, Submittals, Requirements and Procedures for Project Closeout.

1.02 RELATED SECTIONS

Section 01300 - Submittals
Section 01710 - Clean-Up

1.03 SUBMITTALS

A. Construction Completion Requests
   1) Certificate of Substantial Completion
   2) Certificate of Final Inspection

B. Closeout Submittals: Three (3) copies of closeout submittals of which receipt and acceptance are prerequisites for payment shall include, but not necessarily be limited to, the following:

1. Project "As-Built" Drawings
2. Guarantees and Bond
3. Evidence of Compliance with Governing Authorities
   a. Certificate of Inspection
   b. Certificate of Occupancy
4. Affidavit of "Advertisement of Completion"
5. Evidence of Payment, and Release of Liens
6. Contractors "One Year Guarantee"
7. Final Application For Payment
8. List of names of DBE/MBE Contractors used on the project.

1.04 GUARANTEES AND BONDS

A. Contractor shall submit to Program Manager who will submit to Architect before final acceptance all warranties, guarantees, and surety bonds. All such documents shall show the name and the location of the project and the name of the Owner.

1.05 ADVERTISEMENT OF COMPLETION

A. Contractors performing contracts of fifty thousand dollars ($50,000.00) or more shall immediately after the completion of the contract, give notice of the completion by an advertisement in a newspaper of general circulation published within the City or County in which the work was done, once a week for four (4) consecutive weeks.
SECTION 01700 – PROJECT CLOSEOUT

B. In no case will a final settlement be made upon the contract until the expiration of thirty (30) days after the completion of the notice.

C. Proof of publication of this notice shall be submitted by the Contractor to the Program Manager and Architect by affidavit of the publisher and a printed copy of the notice published. If no newspaper is published in the County, the notice must be posted at the courthouse for thirty (30) days and proof shall be made by the Probate Judge, Sheriff and the Contractor.

D. Contractors performing contracts of less than fifty thousand dollars ($50,000.00), shall immediately after completion of the contract, give notice of the completion by an advertisement in a newspaper of general circulation published within the City or County in which the work was done for one (1) week. The Contractor shall furnish the Purchasing Department by affidavit of the publisher a printed copy of the notice published for posting on their bulletin board for one week. The Contractor shall certify under oath that all bids have been paid in full. Final payment with the Contractor will be made after the notice has been posted for one entire week.

1.06 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

A. Submit Contractor's Affidavit of Payment of Debts and Claims: AIA G706, or approved equal.

B. Submit Contractor's Affidavit of Release of Liens: AIA G706A, or approved equal, with:
   1. Consent of Surety to Final Payment: AIA G707, or approved equal.
   2. Contractor's Release or Waiver of Liens
   3. Separate Release of Waivers of Liens for Subcontractors, suppliers and others with lien rights against property of Owner, together with Lien rights against property of Owner, together with a list of those parties.

C. All submittals shall be duly executed before delivery to Program Manager.

1.07 FINAL INSPECTION

A. Certification: Contractor shall submit written certification that: Contract Documents have been reviewed; Project has been inspected for compliance with Contract Documents; Work has been completed in accordance with Contract Documents; Project is completed and ready for final inspection.

B. Inspection: Architect will make final inspection of the project within a reasonable time after receipt of certification. Should Architect consider that Work is in fact complete in accord with requirements of Contract Documents, he will request Contractor to make project closeout submittals. Should Architect consider Work is not complete, he will notify contractor, in writing, stating reasons. Contractor shall take immediate steps to remedy stated deficiencies and send written notice to Architect certifying that Work is complete. Architect will reinspect the Work.

1.08 AS-BUILT DRAWINGS

A. A complete and separate set of prints of the Contract Drawings showing the Work under this contract shall be maintained at the job at all times, on which shall be marked clearly, neatly, accurately, and promptly the progress of the work including:

   1. Changes to be made, whether resulting from formal change orders or other instructions issued by the Architect.
2. The daily progress, by coloring the various stages of Work exactly as they are erected. This progress shall incorporate both the changes noted above and all other deviations from the original drawings, whether resulting from job conditions encountered or from any other causes. Principal dimensions of concealed work shall be recorded.

B. The marked-up and colored prints will be used as a guide for determining the progress of the work installed. They will be inspected monthly by the Program Manager and Architect and they shall be corrected immediately if found either inaccurate or incomplete.

C. At the completion of the job, the marked prints shall be submitted to the Program Manager to submit to the Architect for final review, comment and approval. The prints will be returned with appropriate comments and recommendations, and then a complete set of record “mylar” reproducible sheets shall be prepared by the Contractor incorporating all of the changes and added data noted on the approved marked-up prints. The record “mylar” sheets shall be given to the Architect upon completion and as a requirement prior to the issuance of the "Final" Certificate of Payment. Architect will not provide AutoCAD or other digital format drawings for use by Contractors.

D. “Mylar” reproducible sheets of the original drawings shall be obtained from the Architect with respective cost of reproduction and mailing being borne and paid by the Contractor involved in making the record drawings.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit three (3) sets prior to final inspection, bound in 8-1/2” x 11” binders with durable plastic covers.

B. Prepare binder covers with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS”, title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below, with tab titling clearly printed under reinforced laminated plastic tabs.

D. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, and major equipment suppliers.

E. Part 2: Operation and maintenance instructions, arranged by system and subdivided by section. For each category, identify names, addresses, and telephone numbers of suppliers. Identify the following:

1. Significant design criteria.
2. List of equipment.
3. Parts list for each component.
4. Operating instructions.
5. Maintenance instructions for equipment and systems.
6. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

F. Submit final volumes, revised, to the Program Manager at the required “Instruction on Operation of Systems” meeting outlined in the Closeout Procedure.
1.10 WARRANTIES, GUARANTEES AND BONDS

A. Contractor shall submit to Program Manager before final acceptance all warranties, guarantees, and surety bonds. All such documents shall show the name and location of the project and the name of the Owner.

B. Provide duplicate notarized copies. Execute and assemble documents from suppliers and manufacturers. Provide three (3) complete sets with table of contents and assemble in an 8-1/2" x 11" 3-ring binder with durable plastic covers.

C. Certificate of Asbestos shall certify that no asbestos or products containing asbestos are installed as part of this project.

D. Submit prior to final Application for Payment.

1.11 CONTRACTOR ONE-YEAR GUARANTEE

A. The contractor shall submit in addition to any other expressed guarantees and/or warranties, a guarantee of all work under this contract for a period of one year from date of final acceptance.

1.12 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit final statement of accounting to Program Manager. Statement shall reflect all adjustments, including, but not necessarily limited to, the following:

   a. Original Contract Sum
   b. Additions and Deductions resulting from:
      1. Previous change orders
      2. Cash Allowances
      3. Unit Prices
      4. Other Adjustments
      5. Deductions for Uncorrected Work
      6. Penalties and Bonuses
      7. Deductions for Liquidated Damages
      8. Deductions for Re-inspection Payments
   c. Total Contract Sum, as adjusted
   d. Previous Payments
   e. Sum remaining due

B. Architect will prepare final change order, reflecting approved adjustments to Contract sum not previously made by change orders.

1.13 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit final application in accord with requirements of General and/or Supplementary Conditions.

1.14 DBE/MBE CONTRACTORS

A. After job closeout and before the Contractor receives the final payment of retainage, the

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Contractor will submit to CIA names of DBE/MBE contractors used on the job along with the net dollar amount paid to each such contractor.

1.15 YEAR END INSPECTION

A. Twenty (20) days prior to expiration of one year from date of "Final Acceptance", Contractor shall notify Architect in writing of Year End Inspection. Architect will make visual inspection of the project in company with owner and contractor to determine whether correction of work is required, in accord with provisions of General Conditions. For guarantees beyond one year, Architect will make inspections at request of Owner, after notification to contractor. Architect will promptly notify contractor in writing of any observed deficiencies.

1.16 SPECIAL TOOLS

A. Provide any “special tools” (one of each type), if required as part of the operation and maintenance of any of the systems herein specified. “Special Tools” are devices that are considered unique to a specified system and necessary for maintenance and operation of that system, and not normally part of the Zoo maintenance department inventory.
SECTION 01710 - CLEANING

PART ONE - GENERAL

1.00 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to and form a part of this Section.

1.01 DESCRIPTION:
A. Execute cleaning during progress of the work, and at completion of the work, as required by General Conditions and detailed in section 01010,1.01, Extent of Work (specifically scopes of work).
B. Related requirements in other parts of the Specifications: Section 0700 - General Conditions

1.02 DISPOSAL REQUIREMENTS:
A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and antipollution laws.

PART TWO - PRODUCTS

2.01 MATERIALS:
A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
B. Use only those cleaning materials and methods recommended by cleaning materials manufacturer.
C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART THREE - EXECUTION

3.01 DURING CONSTRUCTION:
A. Execute daily cleaning to keep the work, site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
B. Provide on-site containers for the collection of waste materials, debris and rubbish.
C. Remove waste materials, debris and rubbish from the site.

3.02 FINAL CLEANING
A. Employ workmen for final cleaning.
SECTION 01710 - CLEANING

B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed exterior surfaces.

C. Scratched, marred or other disfigured aluminum or other finished metals shall be replaced.

D. Prior to final completion, Contractor shall conduct an inspection of sight-exposed surfaces and all work areas to verify that the entire work is clean.

E. Upon completion of final cleaning, cleaning equipment, materials and debris shall be removed from the construction site and the premises left clean.

END OF SECTION
SECTION 01781 - PROJECT RECORD DOCUMENTS

PART 1   GENERAL

1.1   RELATED DOCUMENTS

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

1.2   SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Sections:

1. Division 1 Section “Closeout Procedures” for general closeout procedures and for operation and maintenance manual requirements.
2. Divisions 2 through 16 Sections for specific requirements for project record documents of the Work in those Sections.

1.3   CLOSEOUT SUBMITTALS

A. Contractor’s Record Documents: Two sets of record documents will be kept on the project site. The first set will be kept by the Contractor in the Contractor’s office. This set is for the Contractor’s use as a current working set with all changes posted with all changes. At any time this set of contract documents may be inspected for accuracy and completeness by the Program Manager, Architect, or Owner.

B. Official Record Documents: The second set will be considered the Official record set of drawings and specifications and will be housed in the office of the Program Manager. This set will be turned over to the Architect and Owner at the completion of the project. The Contractor is responsible for updating record drawings when a differing condition is identified, and not less than a monthly basis. Each month, prior to submission of that month’s Application for Payment, the Contractor shall meet with the Program Manager to verify that all construction documents changes have been accurately and properly recorded in the record set.

C. Drawings and Specification Change Log: The Contractor shall keep a log of all drawing changes and specification changes that occurred the previous month and back-check the both the Contractor’s Record Documents as well as the Official Record Documents to verify that all changes are included.

D. Within ten days after the Date of Substantial Completion of the Work, or the last completed portion of the Work, the Contractor shall complete the Official Record Documents for approval by the Architect. If the Architect requires that any corrections be made, the documents will be returned in a reasonable time for correction and resubmission.

E. The Program Manager will deliver the Official Record Documents to the Architect for submission to the Owner upon completion of the Work. The set of “As-built” documents shall consist of a copy of the Drawings and Project Manual, in like-new condition, into which the Contractor has neatly incorporated all Addenda, Change Orders, supplemental drawings, clarifications, field
changes, corrections, selections, actual locations of underground utilities, and other information as required herein or specified elsewhere in the Contract Documents.

F. The Contractor shall use the following methods for incorporating information into the “As-built” documents:

1. Where a revised drawing has been furnished by the Architect, the drawing of latest date shall be bound into the Drawings in the place of the superseded drawing.

2. Where a supplemental drawing has been furnished by the Architect, the supplemental drawing shall be bound into the Drawings in an appropriate location and referred to by notes added to the drawing being supplemented.

3. Any entry of information made in the Drawings that is the result of an Addendum or Change Order, shall identify the Addendum or Change Order from which it originated.


5. Where a document, form, or entire specification section is revised, the latest issue shall be bound into the Project Manual in the place of the superseded issue.

6. Where information within a specification section is revised, the deleted or revised information shall be struck through and an adjacent note added identifying the Addendum or Change Order containing the revised information.

PART 2 PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Work Change Directive.
k. Changes made following Architect’s written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
3. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy and scanned PDF electronic file(s) of marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer’s written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy and scanned PDF electronic file(s) of marked up paper copy of Product Data.

1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as paper copy and scanned PDF electronic file(s) of marked up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.
SECTION 02220 - SELECTIVE SITE DEMOLITION

1. GENERAL

1.01 Section Includes

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

B. Selective site demolition of designated items; including removal of materials from site, legal disposal off-site and salvage of items which are identified on the plan documents for Owner.
   1. Existing structures including exhibits; including below grade foundations.
   2. Storm sewer piping, structures and appurtenances.
   3. Water services, fire hydrants, valves and appurtenances.
   4. Asphalt paved areas; including saw-cutting.
   5. Concrete walks, slabs, curbs and concrete islands; including saw-cutting.
   6. Concrete curb and gutter; including saw-cutting.
   7. Miscellaneous foundations in their entirety.
   8. Tree and landscape removal; including roots.
   9. Tree removal for selected trees for reuse on site for animal exhibits.
  10. Fencing, sewer pipe, sewer structures, water main, light poles, bollards, fixtures and associated foundations.
  11. Site signage, posts and bollards.
  12. Below grade structures including Bird Island (old Monkey Island).

C. Demolition and removal of identified utilities.

1.02 Related Sections

A. Section 02230 – Site Clearing.
B. Section 02300 - Earthwork.
C. Section 02322 – Excavation, Backfill and Compaction for Utilities
D. Section 02325 – Aggregate Materials
E. Section 02370 - Erosion and Sedimentation Control.
F. Section 02930 – Landscaping.
G. Division 15 and 16 – For electrical demolition.

1.03 Submittals

A. Submit under the provisions of Division One Specifications.

B. Schedule: Indicate demolition and removal sequence and location of salvageable items; location and construction of barricades, fences and temporary work. Certification: Submit written certification by Arborist that trees indicated to remain have been protected during the course of construction in accordance with recognized standards of the industry and as directed herein. Where damage has occurred, trees were promptly and properly treated. Indicate which damaged trees, if any, are incapable of retaining full growth potential and are recommended to be replaced.

1.04 Project Record Documents
A. Submit under the provisions of Division One Specifications.

B. Accurately record actual locations of capped utilities, subsurface obstructions and any other items relocated.

1.05 Regulatory Requirements

A. Conform to Alabama State Building Code and all applicable codes for demolition of site structures, safety of adjacent structures, dust control, run-off control and disposal.

B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.

C. Notify affected utility companies before starting work and comply with their requirements, as outlined under the provisions of Division One Specifications.

D. Do not close or obstruct roadways, sidewalks or hydrants without permits.

E. Conform to applicable building codes for dust control and run-off control.

F. Conform to applicable regulatory procedures when hazardous or contaminated materials are discovered.

G. Test soils around buried tanks for contamination

1.06 Site Conditions

A. The Contractor is to visit the site and review all plans, specifications and geotechnical reports prior to bidding. No additional compensation will be allowed for items that could have been clarified prior to bidding.

B. Provide traffic control per City and Owner requirements and meet all permit requirements.

C. Coordinate all Work with Construction Manager.

D. Protection of Persons: The Owner’s activities will continue in and about the site during construction. Install warning signs, barricades, temporary fences and warning lights as part of this Work.

E. Protection of Trees: Within and adjacent to the construction site, maintain trees noted to remain in a healthy and flourishing condition until final acceptance of the project.

F. Selective Tree Demolition: Contractor shall flag all trees scheduled for demolition for Owner written approval prior to demolition. Some removed trees shall be salvaged for reuse by the Owner within animal exhibit areas outside of project site but within the Zoo grounds (these salvaged trees shall be located as directed by the Owner). Contractor shall coordinate with Owner which trees shall be salvaged for reuse for exhibit deadfall. Salvaged trees shall be felled in a manner to minimize damage to the tree and existing branching and to retain the root ball in its entirety. Contractor shall trim tree only as directed by Owner.

G. The health of the existing trees to remain within and just beyond the project boundary is of significant importance to the Owner and the success of this project. No work shall be performed within the dripline of existing trees, or the area immediately beyond the dripline, to remain unless specifically identified on the drawings and Owner notified prior to commencing work. The Contractor shall perform construction operations with utmost care when in proximity of existing trees.
H. Existing Utilities: Locate and mark all existing utilities that are on site where the Work is to be performed.

I. Benchmarks and Monuments: Maintain benchmarks and monuments that exist on the site.

J. Protection of Existing Property to Remain: Protect existing plants, equipment and structures that are in areas where Work will be performed and which are to remain. Repair or replace existing property that is to remain that is damaged by the Work of this Contract, to the Architect/Engineer’s satisfaction and at no cost to the Owner.

K. APCO and AT&T will be on site for the demolition and removal of existing services and installation of new underground services. The Contractor shall be responsible to coordinate the work performed by APCO and AT&T and all restoration work required to bring the site to its original or proposed condition.

L. Structures to be demolished will be discontinued in use and vacated prior to start of work.

M. Owner assumes no responsibility for condition of structures to be demolished.

N. Conditions, existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

O. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified in Contract Documents.

P. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

Q. In addition to previously listed safety rules to be observed in performance of work, include following:
   1. No wall or part of wall shall be permitted to fall outwardly from structures.
   2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
   3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 15 feet of fire hydrants.

1.07 Quality Assurances

A. Trees to be retained shall be identified on site before commencing work under this agreement, and any discrepancies between site conditions and Contract Documents shall be brought to the attention of the Owner's Representative before any clearing begins. Mark trees to be removed and obtain Owner's Representative's written approval before demolition.

B. In the event that any operation is likely to damage branches, roots or trunk of any tree to be protected, notify the Owner's Representative in writing seven days in advance of commencing that operation. Work should be done in accordance with the drawings or otherwise directed by Owner.

C. Arborist: Owner shall provide Certified Arborist to perform the following work:
   1. Recommend procedures to compensate for loss of roots and perform initial pruning of
branches and stimulation of root growth where removed to accommodate new construction.
2. Perform minor tree repair work for damages incurred by new construction. If in the opinion of the Arborist, major tree repair work is required, the Arborist shall perform the work at the expense of the Contractor.
3. Remove branches from trees that are to remain to clear new construction.

2. PRODUCTS
2.01 Demolition Fill Materials
A. Fill Materials: Types specified in Section 02300.

2.02 Erosion Control and Silt Fences
A. Reference to Section 02370 – Erosion and Sedimentation Control.
B. Follow all City of Birmingham and ADEM standards and specifications.

3. EXECUTION
3.01 Preparation
A. Provide, erect and maintain temporary barriers, traffic control and security devices at locations as directed by the Architect/Engineer, City and Owner.
B. Protect existing landscape materials, appurtenances, and structures that are not to be demolished. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning or roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
C. Prevent movement or settlement of adjacent structures. Provide bracing or shoring.
D. Mark location of utilities.
E. All erosion control measures are to be installed and approved by the City prior to start of construction.

3.02 Demolition Requirements
A. Conduct site demolition to minimize interference with adjacent structures.
B. Cease operations immediately if adjacent structures appear to be in danger. Notify the Construction Manager and do not resume operations until directed.
C. Conduct operations with minimum interference to public or private accesses. Maintain protected egress and access at all times.
D. Obtain written permission from adjacent property owners (both private and public) when demolition equipment will traverse, infringe upon or limit access to their property.
E. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.

3.03 Clearing and Removal
A. General: Remove structures and facilities indicated on the Drawings. Remove and dispose of all structures, except for that which is permitted to remain upon determination being made by the Architect/Engineer that their existence does not interfere with, endanger or detract from the new construction in any way.

B. Removal Operations: Perform removal operations that may endanger new construction prior to construction of affected Work.

C. Compliance with Instructions, Ordinances and State Laws: Comply with all instructions and ordinances of the State of Alabama, and all counties and municipalities regarding disposals, signs, advertising, traffic corners, danger signals, barricades, fire protection and all safety laws, ordinances and rulings.

D. Disposal of Materials and Debris: Dispose of debris resulting from the removal and demolition operations in accordance with specific regulations imposed by laws, ordinances, orders and decrees.

E. Removal of Existing Structures: Remove and dispose of all structures, except for those that are specified to be removed by others or which are permitted to remain upon determination being made by the Architect/Engineer that their existence does not interfere with, endanger or detract from the new construction in any way. Catch basins and manholes designated for removal shall be removed entirely and the pipe leads closed per City standards. Manholes designated to remain shall be clearly marked in the field and protected at all times.

F. Removal of Existing Pavements: Where a portion of an existing pavement is to be retained for use, that portion shall not be damaged during removal operations. In removing concrete and bituminous pavements, sidewalks and similar structures, where the cut will be exposed in the finished Work, the structure shall, unless the removal is made to an existing joint and unless determined otherwise by the Architect/Engineer, be sawed along the removal lines with a concrete saw to a depth of not less than one-third (1/3) the thickness of the concrete or bituminous before breaking off the concrete or bituminous. In such cases, the use of wedges, driven into the saw cut to break off the portion to be removed, will not be permitted. Elsewhere, the structure shall be cut and chipped to true lines and vertical faces.

G. Removal of Trees, Stumps, Brush and Vegetation: The clearing operations shall consist of the cutting and removal of trees, shrubs, bushes, windfalls and other vegetation in the designated areas except for trees salvaged for reuse. Grubbing operations shall consist of removing and disposing of the stumps, roots and other remains in their entirety.

H. Disconnect, remove and/or cap designated utilities within demolition areas.

I. All materials removed under this section shall be removed from the site. The cost of legal disposal of the existing materials shall be included in the Bid Price, and no additional compensation will be allowed.
   1. Place silt fence around perimeter of all stockpiles.

3.04 Special Precautions

A. Dewatering:
   1. Prevent surface water and subsurface (ground) water from flowing into evacuations and from flooding the site and surrounding area.
   2. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades and foundations. Provide and maintain pump, well points, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
   3. Convey water removed from excavations and rainwater to legal collection or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside
excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
4. The cost of dewatering shall be considered part of the Base Bid Contract.

B. Maintenance, Repair and Treatment of Trees and Tree Protection Zones

1. Maintain construction fence in specified location and good condition until completion of site operations and of delivery of equipment and material, except where directed otherwise in writing by the Architect.

2. Construction Fence that must be temporarily moved to allow for work within protection area shall be fully coordinated with the Owner prior to moving. Contractor shall mark original location of fence on ground with spray paint to insure proper re-location. Construction Fence must be reinstalled in exact location immediately upon completion of this work or at the end of the day, whichever comes first.

3. In the event that operations damage or destroy Construction Fence, the Contractor shall immediately repair or replace said protection to the approval of the Owner.

4. In the event that operations damage an existing tree to remain, the Contractor shall immediately secure the services of a certified Arborist to perform necessary and reasonable repair and treatment to assure future health and vigor of the tree using ISA Best Management practices. In the case where the tree is determined unable to regain and maintain health and vigor, see 3.9 Damages.

C. Use of Area Under or Adjacent to Protected Trees and Trees Outside of Project Boundary

1. Do not store materials or equipment immediately adjacent to or leaning against the trunk of trees to remain.

2. Do not store materials within or under the drip line of trees to remain or trees outside of project boundary.

3. Do not drive or park any vehicle under or within the drip line of trees to remain or trees outside of project boundary.

4. Alter no grades between the trunk and 5’ beyond the drip line, unless indicated otherwise, of any tree to remain.

5. Do not allow fires under/adjacent to the drip line of trees to remain and trees outside of project boundary.

6. Do not allow any materials or chemicals, solid or liquid including but not limited to petroleum products, paints, lime, grout or cement, to be dumped within drip line of trees to be saved or trees outside of project boundary.

D. Excavation and Demolition Around Trees

1. Where demolition and/or trenching for demolition is required within the drip line of trees to remain, hand excavate and hand cut roots and branches to be removed to minimize damage to the root system.

2. Do not use heavy equipment, trucks and/or other vehicles within drip line of trees to remain.

3. Vehicular access between protected trees must be reviewed with the Owner prior to the commencement of construction.
4. Where trenching for utilities is required within the drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots; cut smaller (less than ¾” diameter) roots which interfere with installation of new work. Cut roots with sharp pruning instrument under the direction of a certified Arborist, do not break, chop or rip.

5. Where excavation for new construction is required within the drip line of trees, hand excavate to minimize damage to root system. Provide sheeting at excavations if necessary. Use narrow tine spade forks and comb soil to expose roots.

6. Do not allow exposed roots to dry out before permanent backfill is placed. Provide temporary earth cover, or place filter fabric and 8” to 12” of wood mulch over root area to be saved. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with earth. Arborist shall prune branches to balance root system caused by damage or cutting of root system. Keep all power equipment and vehicles off these areas.

7. Relocate roots in backfill areas wherever possible. Notify Owner’s Representative for coordination prior to relocating. If large, main lateral roots are encountered (greater than 1” diameter), expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, the Contractor shall provide notice to the Owner’s Representative and shall await Owner Representative’s site visit and approval before proceeding. Relocate roots at same elevation from which they were removed.

E. Grading and Filling Around Trees

1. Maintain existing grades within drip line of all trees unless otherwise indicated.

2. Lowering Grades: Where existing grade is above new finished grade shown around trees, carefully hand excavate within drip line to new finished grade. Cut roots exposed by excavation or provide permanent protection as recommended by Arborist.

F. Filling Depressions

A. Depressions caused by tree removal operations shall be filled and compacted per Section 02300- Earthwork.

G. Damage for Loss or Injury to Trees

A. Remove dead trees caused by Contractor’s failure to maintain Construction Fence or as a direct result of damage inflicted during the demolition contract. Remove damaged trees which are determined by the Owner’s Representative and/or Landscape Architect to be incapable of restoration to normal growth pattern and if the Owner chooses removal.

B. In the event of a tree lost or damaged beyond recovery, the Contractor shall pay to the Owner as liquidated damages, a sum equal to the value of each lost tree as determined by the most current Guide for Plant Appraisal by the Council of Tree and Landscape Appraisers, plus the amount of $1500.00 per tree in compensation for the efforts of the Owner in administering and overseeing the replacement.

C. In the event only a portion of the tree is killed or severely damaged the Contractor shall pay to the Owner a prorated portion of the damages obtained in 3.04G based upon the proportion of the trees canopy which has been damaged.

D. In the event of a damaged tree, the Owner reserves the right to keep the damaged tree as well
as collect damages and compensation per 3.04G above.

3.05 Disposal of Waste Materials
   A. Burning of debris is not permitted on the Owner’s property.
   B. Remove all waste materials and unsuitable or excess topsoil from the Owner’s property.
   C. The cost of disposal of waste materials is considered part of the Base Bid Contract.

3.06 Cleaning
   A. Clean Work under the provisions of Division One Specifications.
   B. Clean the site of all debris and unused materials, and remove from site.
   C. Keep all public roadways free of mud, soil and debris to the satisfaction of regulatory agencies.

END OF SECTION
SECTION 02230 - SITE CLEARING

1. GENERAL

1.01 Section Includes

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

B. Remove trees, underbrush, undesirable growths, stumps, roots, etc. From the area to the limits indicated on the Drawings, specified herein, and as required to meet the contract documents.

C. Site clearing operations:
   1. Selective site clearing and grubbing of trees and brush
   2. Selective tree removal and trimming
   3. Stripping topsoil
   4. Stockpiling of topsoil

D. Special precautions
   1. Dewatering

1.02 Related Sections

A. Section 02220 - Selective Site Demolition

B. Section 02300 - Earthwork

C. Section 02322 – Excavation, Backfill, and Compaction for Utilities

D. Section 02370 – Erosion and Sedimentation Control

1.03 Quality Assurance

A. Codes and Standards: Perform excavation work and disposal of debris in accordance with applicable requirements of governing authorities having jurisdiction.

B. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this section.

C. Use equipment adequate in size, capacity and number to accomplish the Work in a timely manner.

D. Comply with requirements of governmental agencies having jurisdiction.

1.04 Site Conditions

A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied facilities. Do not close or obstruct streets, walks or other occupied facilities without written permission from authorities having jurisdiction.

B. Protection of Persons: The Owner’s activities may continue in and about the site during construction. Install barricade fencing (snow fence), as necessary, to provide a safe environment between construction work and pedestrian circulation.

C. Existing Utilities: Locate and mark all existing utilities that are on the site where the Work is to be performed. Refer to Division One Specifications for other information.
D. Benchmarks and Monuments: Maintain benchmarks and monuments existing on the site.
E. Protection of Existing Property to Remain: Protect existing plants, equipment and structures that are in the area where the Work will be performed and which are to remain. Repair or replace existing property that is to remain that is damaged by the work, to the Architect/Engineer’s satisfaction and at no cost to the Owner.

2. PRODUCTS

2.01 Tree Protection

A. Temporary Fencing: Polyethylene (snow fence) or chainlink fence as shown on the drawings.
B. Mulch: Shredded hardwood bark 3/4” - 1 1/2” diameter.

3. EXECUTION

3.01 Site Clearing

A. General: Remove trees, shrubs, grass and other vegetation, improvements or obstructions as required to permit installation of new construction. Remove similar items elsewhere on the site or the premises as specifically indicated on the Drawings. “Removal” includes digging out and off-site disposal of stumps and roots.
B. Topsoil: Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
C. Remove heavy growths of grass from areas before stripping. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
D. Stockpile topsoil (if required) in storage areas indicated or directed by the Construction Manager, Owner, Architect or Engineer. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion and place silt fence around perimeter.
E. Coordinate amount of topsoil to be stockpiled with the Construction Manager. The topsoil is to be tested by the soil testing agencies to assure it meets the landscape specifications. Exporting or importing of topsoil is considered part of the Base Bid Contract.

3.02 Clearing and Grubbing

A. Clearing and Grubbing: The entire area within the limit lines described above shall be cleared and grubbed. Remove all vegetation, trees, brush, stumps, etc. from the area. All debris from this operation shall be disposed of off the Owner’s property.
B. Selective clearing shall be done in areas designated by the Architect/Engineer. Selective clearing shall consist of removing vegetation, brush, stumps, etc. from the area. Selected trees shall be left standing and care shall be taken to protect trees designated to remain. All debris from this operation shall be disposed of off the Owner’s property. Grubbing will not be required in areas designated for selective clearing.
C. Cutting and removing trees, shrubs, bushes, windfalls and other vegetation: Cut brush within six (6”) inches of the ground surface. Remove, as directed, any low hanging, unsound or unsightly branches on the trees and shrubs designated to remain.
D. Remove and dispose of stumps, roots and other remains. Remove stumps completely. Except in areas to be excavated, backfill depressions resulting from the grubbing operations with suitable material and compact to the specified requirements.

E. Remove timber, stumps, roots and other debris or by-products resulting from the clearing and grubbing operations from the site. If any wood is run through a chipping machine, the wood chips shall be immediately recovered and disposed of off the site.

F. Grubbing operations shall consist of removing and disposing of the stumps, roots and other remains in the construction area in their entirety.

G. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated on the Drawings or as necessary to facilitate new construction.

3.03 Preparation

A. Identify required lines, levels, contours and datum. Verify that survey benchmark and intended elevations for the Work are as indicated on the Drawings.

B. Identify known underground, above ground and aerial utilities. Stake and flag locations. Protect above- and below-grade utilities which are to remain.

3.04 Protection

A. Protect utilities that remain, from damage.

B. Protect trees, plant growth and features designated to remain as final landscaping.

C. Protect benchmarks, existing structures, fences, sidewalks, paving, curbs and other items indicated on the Drawings to remain.

D. Protection of trees: It may become desirable to save certain trees in areas where cut or fill is eighteen (18") inches or less. Consequently, the Contractor shall obtain approval from the Architect/Engineer prior to removal of significant trees from such areas. The Contractor shall protect existing trees to remain during construction by constructing barricades around such trees as directed.

3.05 Special Precautions

A. Dewatering:
   1. Prevent surface water and subsurface (ground) water from flowing into excavations and from flooding the site and surrounding area.
   2. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
   3. Convey water removed from excavations and rainwater to legal collection or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
   4. The cost of dewatering shall be considered part of the Base Bid Contract.

3.06 Disposal of Waste Materials

A. Burning of debris is not permitted on the Owner’s property.

B. Remove all waste materials and unsuitable or excess topsoil from the Owner’s property.

C. The cost of disposal of waste materials is considered part of the Base Bid Contract.
3.07 Cleaning

A. Clean Work under the provisions of Division One Specifications.

B. Clean the site of all debris and unused materials, and remove from site.

C. Keep all public roadways free of mud, soil and debris to the satisfaction of regulatory agencies.

END OF SECTION
SECTION 02300 - EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

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

B. Earthwork Operations:

1. Site clearing and grubbing
2. Site preparation, protection and special precautions
3. Stripping operations and stockpiling of soils to be re-used
4. Importing approved soils for fill
5. Excavation and removal (off-site) of soils not to be re-used
6. Excavation for pavements; including roadways, parking areas and walkways
7. Excavation for building foundations
8. Building and site backfilling and soil compaction operations
9. Subsoil amendments.
10. Rough grading; including cutting, filling, compaction operations, preparing of sub-grade to receive pavements.
11. Construction under building floor slabs.
12. Free-draining, non-frost susceptible granular material for sub-base under buildings and pavement areas.
13. Relocation of existing soils on-site for specific uses; including topsoil, structural fill under building areas, parking lots and roads.
14. Finish grading; including spreading topsoil/soil mixes.
15. Soil testing of topsoil and soil mixes.
16. Soil Amendments as per soil test results.
17. Tilling and scarifying the subgrade within landscaped areas prior to placing topsoil mixes.

1.2 RELATED SECTIONS

A. Section 02220 – Selective Site Demolition
B. Section 02230 – Site Clearing
C. Section 02322 – Excavation, Backfill, and Compaction for Utilities
D. Section 02370 – Erosion and Sedimentation Control
E. Section 02535 – Sanitary Sewer Systems
F. Section 02630 – Storm Drainage
G. Section 02740 – Asphalt Concrete Paving
H. Section 02750 – Exterior Concrete Pavement
I. Section 02930 – Landscape Work
J. Division 15 and 16 – For coordination with Electrical and Plumbing

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
2. ASTM D75-03, “Practice for Sampling Aggregates.”
4. ASTM D698-00, “Test Methods for Laboratory Compaction of Soil Using Standard Effort.”
5. ASTM D1556-00, “Test Method for Density of Soil by the Sand-Cone Method.”
6. ASTM D1586-99, “Penetration Test and Split-Barrel Sampling of Soils.”
7. ASTM D2487-00, “Classification of Soils for Engineering Purposes (Unified Soil Classification System).”
9. ASTM D2922-01, “Test Methods for Density of Soil and Soil Aggregates in Place by Nuclear Methods (Shallow Depth).”

1.4 SUBMITTALS

A. Submit under provisions of Division One Specifications.
B. Samples: Submit thirty (30) pound sample of each type of fill to Independent Testing Laboratory, in airtight containers.
C. The Owner will contract with an Independent Testing Laboratory to perform a sieve analysis and moisture-density tests for each type and source of fill material from samples supplied by the contractor.
D. Soil Test Reports: The Independent Testing Laboratory shall submit soil test reports which pertain to testing services performed at the site under the provisions of Division One Specifications. Test reports are to be submitted to the construction manager and engineer for review.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work and disposal of debris in accordance with applicable requirements of governing authorities having jurisdiction.
B. All excavations and trenches shall comply with the requirements of OSHA 29 CFR, Part 1926, Sub-Part B, “Excavations and Trenches.”
C. The Contractor is to employ the services of a Registered Land Surveyor, registered in the State of Alabama, to perform the specified layout work and to prepare a grade verification survey. Refer to Part 3.14 of this section.
D. After the date of Substantial Completion and prior to the release of retainage, the Record Drawings shall be transmitted to the Architect/Engineer.

1.6 SITE CONDITIONS

A. The Contractor shall visit the site and review all plans, specifications and geotechnical reports prior to bidding. No additional compensation will be allowed for items that could have been clarified prior to bidding.
B. The Landscape Drawings and Specifications indicate depths, compaction percentages, and soil amendments for soils and subsoils in soil mix areas within the landscaping. Prior to placing the manufactured topsoil mix, the subgrade area shall be tilled to loosen the existing soils to aid in establishing the landscape plants and in the soils ability to infiltrate storm water. These areas shall be fenced off to prevent construction traffic from compacting the surrounding soils once the topsoil has been placed.
C. Protection of Persons: The Owner's activities will continue in and about the site during
construction. Install barricade fencing (snow fence), as necessary, to provide a safe environment between construction work and student/pedestrian circulation.

D. Cold Weather Protection: Do not allow frost and snow to occur within materials beneath footings and slabs. Protect the soils to prevent freezing until after footings have been poured and until fill has been placed and compacted. Completely remove frost and snow, if present, before the footings are poured and the under slab fill is placed.

E. Existing Utilities: Locate and mark all existing utilities, which are on the site where the Work is to be performed.

F. Benchmarks and Monuments: Maintain benchmarks and monuments existing on the site.

G. Protection of Existing Property to Remain: Protect existing plants, equipment and structures, which are in area where Work will be performed and which are to remain. Repair or replace existing property, which is to remain that is damaged by the Work, to the Architect/Engineer’s satisfaction and at no cost to the Owner.

1.7 UNIT PRICES

A. Unit prices are covered under the provisions of Division One Specifications.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Topsoil:

1. Materials considered useful for topsoil by the Architect shall be stockpiled at his direction at locations shown on the Drawings or as directed in the field. Topsoil shall be kept free from sub-soil, clay lumps, brush, objectionable weeds, litter, stones larger than 2 inches in diameter, stumps, roots, and other materials that would interfere with planting and maintenance operations.

2. Use topsoil stockpiles on site as necessary to complete landscape work indicated on Drawings and in accordance with specifications for landscaping.

C. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, SM, and CL or a combination of these group symbols; virtually free of rock or gravel larger than 4 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

D. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CH, OL, OH, and PT, or a combination of these group symbols as well as alluvial soils and organic soils.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

E. Backfill and Fill: Satisfactory soil materials.

F. Subbase ALDOT 821: At least 90 percent passing a 1-1/2 inch (38 mm) no more than 35% passing a No. 200 (0.075-mm) sieve.
G. Base: ASTM D2940 and/or ALDOT 825; with at least 95 percent passing a 1-1/2 inch (38-mm sieve and not more than 12 % passing a No. 200 (0.075-mm) sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state with a permeability rate of $1 \times 10^{-7}$ cm/sec.

2.2 ACQUISITION OF MATERIALS

A. Insufficient Materials: Provide necessary material from off the site, as approved by the Architect/Engineer and Geotechnical Engineer to complete the Work. The cost of these materials shall be considered part of Base Bid Contract.

B. Exterior Backfill: Clean, on-site materials obtained from the required stripping, contour cutting and excavation may be used for backfill and grading.

C. Subsoil for Site Grading: Clean, on-site materials obtained from the earthwork operations.

D. Under Slab Fill: Obtain from on or off the site as approved by the Laboratory Inspector.

E. Under Footing Fill: Obtain from on or off the site as approved by the Laboratory Inspector.

F. Borrow pits: Borrow pits will not be permitted on this project.

2.3 DISPOSITION OF MATERIALS

A. Surplus Earth: Unless designated elsewhere for use or disposal on the Owner’s property, surplus earth becomes the property of the Contractor and shall be removed from the Owner’s site. The cost of off-site disposal shall be considered part of the Base Bid Contract.

B. The Contractor shall not be allowed to take advantage of the stated tolerances by maintaining a consistently high or low elevation.

2.4 MATERIAL BALANCE

A. The Contractor shall be responsible for determining the quantities of material necessary for completing the Work under this Section. This includes the cost of importing approved fill or exporting excess materials.

2.5 ADDITIONAL SOIL CORRECTION

A. The Owner recognizes that some unforeseen conditions may be encountered during excavation and, therefore, is soliciting unit prices in order to protect the interests of both parties.

B. Additional Soils Correction: The Contractor shall use the geotechnical report in preparing the estimate for soils correction under the building. Should the Contractor be directed by
the Geotechnical Engineer to remove additional unsuitable soils under the building or paved areas, which are beyond the excavation depths indicated in the Soils Investigation Report, then the following procedure, shall be implemented.

1. Cease all work and contact the Architect who may request that a surveyor shoot the bottom of the excavation at the elevation called for in the geotechnical report. This is the “before” condition.
   a. Excavate until the Geotechnical Engineer indicates that suitable subgrade has been reached.
   b. Request that the surveyor shoot the bottom of the excavation. This is the “after” condition.
   c. Compensation will be made on the basis of the volume computed between the “before” and “after” surfaces. No compaction factor shall be applied to this volume.
   d. A unit price shall include additional excavation including disposal of unsuitable soils.
   e. A unit price shall include additional fill, placed and compacted as specified.
   f. The unsuitable soils excavated above shall be removed from the site or may be used outside of the building and pavement areas if approved by the Geotechnical Engineer with no additional compensation allowed.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING
   A. Refer to Specification Section 02230 – Site Clearing.

3.2 PREPARATION
   A. Identify required lines, levels, contours and datum. Verify that survey benchmarks and intended elevations for the Work are as indicated on the Drawings.
   B. Identify known underground, above ground and aerial utilities. Stake and flag locations. Protect above- and below-grade utilities which are to remain.
   C. Verify that erosion control devices are in place.
   D. Verify limits of construction and accurately locate the site boundaries, building perimeter and paved areas.

3.3 PROTECTION
   A. Protect utilities that remain, from damage.
   B. Protect trees, plant growth and features designated to remain as final landscaping.
   C. Protect the landscaped areas from over compaction once these areas have been tilled and scarified prior to placing the manufactured topsoil mix.
   D. Protect benchmarks, existing structures, fences, sidewalks, paving, curbs and other items indicated on the Drawings to remain.

3.4 SPECIAL PRECAUTIONS
   A. Dewatering:
1. Prevent surface water and subsurface (ground) water from flowing into excavations and from flooding the site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

3. Convey water removed from excavations and rainwater to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

4. The cost of dewatering shall be considered part of the Base Bid Contract.

B. Stability of Excavations:

1. Sidewalls of all excavations shall comply with the most current OSHA regulations and applicable local building codes and ordinances. Shore and brace where adequate sloping is not feasible because of space restrictions or stability of material being excavated.

2. Maintain slopes of excavations in safe condition until completion of backfilling.

C. Cold Weather Protection:

1. Protect excavation bottoms and bearing surfaces against freezing when atmospheric temperature is less than 35 degrees Fahrenheit (2 degrees C).

3.5 EXCAVATIONS

A. Excavate and remove all soil with organic content within areas of the proposed building and all paving areas. Remove any soft soils that are unsuitable for loads as directed by the Geotechnical Engineer. No proposed building footings or slabs-on-grade shall bear on soil with questionable bearing capacity.

B. Unauthorized Excavation: The Contractor shall not be permitted to fill the underfootings with any other material other than concrete in cases where materials are removed beyond the indicated subgrade elevations without the specific directions of the Architect/Engineer. If excavation is made too deep, it shall be filled with foundation strength concrete to the proper footing elevation at the Contractor's expense.

C. Oversize excavations at least two (2') feet plus one (1') foot horizontally from face of building for each one (1') foot of excavation below finish floor grade (1:1 oversizing).

D. Excavate to the lines, grades and slopes as indicated on the Drawings.

E. Provide temporary drainage where construction interferes with existing drainage.
F. Protect and brace existing footings before performing soil corrections within the zone of influence below the existing footings. The zone of influence is defined as the area below a line commencing three (3') feet outside the footing at footing elevation and extending down at a slope of one (1') foot vertical for each foot horizontal. The Contractor shall stop and consult the Geotechnical Engineer and Structural Engineer if it appears that soil correction is required within the zone of influence of the existing footings.

G. Stabilizing Sides of Excavation: Slope the sides of excavations to a safe angle of repose for materials being excavated. Shore and brace where sloping is not possible because of space restrictions or the stability of the materials being excavated. Maintain the sides of the excavations in a safe condition until the completion of backfilling.

3.6 EARTHWORK REQUIREMENTS

A. Earthwork Procedures for Paved Roadways, Walkways and Parking Areas:

1. Remove pavement and/or strip topsoil from areas not cleared under Section 02220 or Section 02230. This Work shall be considered part of the Base Bid Contract.
2. In cut areas, at stable subgrade conditions, subcut only to the depth required to accommodate the pavement and base thickness.
3. Prior to placing fill materials, proof roll subgrade using a loaded truck or similar equipment to detect soft or loose zones where additional excavation depths may be required.
4. All unsuitable material shall be excavated and removed from pavement areas as directed by the Geotechnical Engineer.
5. In fill areas, provide granular fill, placed in twelve (12") inch loose layers and compact each layer to 100 percent Standard Proctor Density in accordance with ASTM D698, to bring grade up to underside of granular subbase for pavements.
6. Pre-compact entire area to be paved to 100 percent Standard Proctor Density in accordance with ASTM D698, just prior to placing stabilized aggregate base for pavements.
7. For roadways and parking areas, refer to Section 02740 for stabilized aggregate base and asphalt pavement.

B. Building Floor Slabs and Footings:

1. Remove surface topsoil from building pad areas that was not removed under Site Clearing and Grubbing. No additional compensation will be allowed for this work.
2. The Contractor is to thoroughly review the Geotechnical Report, Grading Plans, Structural Plans and Specifications to determine depth of excavation and any soils correction required. No additional compensation will be given for work that could have been anticipated by reviewing the above documents.
3. The soil corrections shall conform to the requirements of the soils report and the onsite observations of actual conditions made by the Independent Testing Agency. The Geotechnical Engineer shall inspect footing excavation bottoms. The contractor shall comply with the required corrective procedures to obtain satisfactory footing excavation bottoms.
4. The exposed subgrade soils shall be tested by the Independent Testing Agency. Remove and replace unsuitable soils as directed by the Geotechnical Engineer. No additional compensation will be allowed for exporting or importing of soils.
5. The compacted building pad area shall be brought to true even plane to the base of the sand cushion elevation.

3.7 BACKFILLING PROCEDURES

A. Employ a placement method that does not disturb or damage foundation perimeter drainage, foundation dampproofing and protective cover.
B. Slope grade away from building minimum two (2") inches in ten (10') feet, unless noted otherwise.

3.8 SITE GRADING

A. Rough Grading: Spread subsoil to a depth as described in the Landscape Specification Section 02930. Soil most suitable for lawns shall be spread as top layer. Rough grading shall include spreading the material on the site smoothly and evenly with a dozer or equal equipment, leaving it similar to backdragging with a dozer. Subsoil shall be amended to the depths indicated in paragraph 2.03 section 2930. Refer to Landscape plan for location of soil amendments.

B. Finish Grading: Spread topsoil to depth indicated in Specification Section 02930 and spread seed, apply sod or landscape plants. Refer to Landscape Plan for planting schedule.

C. Compaction: Compact subsoil and topsoil as necessary to prevent settlement without inhibiting vertical drainage and subsequent turf establishment. See Specification Section 02930 for compaction percentages for subsoil not subject to structural loading, and topsoil, in soil mix areas. If over-compaction occurs, the Contractor will be required to re-till and scarify the soil and re-blade. The minimum depth of the topsoil shall be measured after compaction.

3.9 COMPACTED FILL

A. Prior to the placement of fill, the Geotechnical Engineer must inspect and approve the bottom or bearing surface of each excavation. Once approved, the exposed surfaces shall be compacted to at least 100 percent Standard Proctor Density using a vibratory compactor having a minimum drum diameter of 3-feet.

B. Before placing fill on a slope greater than five (5) horizontally to one (1) vertically (5:1), the Contractor shall, at his/her option: (a) flatten the existing slope to the extent that it will not be steeper than 5:1; or (b) construct steps in the slope, with the back surface being as nearly vertical as practicable and with the horizontal cuts being made as close together as the slope permits, but with no step being less than ten (10') feet in width.

C. Fill shall not be placed on frozen ground, nor shall filling operations continue when the temperature is such as to permit the layer under placement to freeze.

D. Deposit approved fill in uniform layers not exceeding eight (8") inches (loose) thickness. Compact each layer with approved methods and equipment.

E. The fill material, when being compacted, shall contain the moisture content necessary for the required compaction as designated by the Geotechnical Engineer. The soil shall be moisture conditioned to within 2 percent of optimum moisture content. The moisture shall be uniform throughout each layer.

F. Scarify, remove, recompact or otherwise rectify all soft or yielding areas resulting from construction operations, rain or other sources at no additional cost to the Owner.

G. Compaction of Trenches for Underground Piping:

1. General Requirements: Place the fill and compact in connection with the installation of the underground plumbing pipe in the Division 15 and 16 as follows:

   a. Interior and Exterior: Refer to Section 02320 - Trench Excavation and Backfill for Utilities.

   2. Coordination: The Contractors shall cooperate in the digging, backfilling and
3.10 COMPACTION DENSITY REQUIREMENTS

A. Compaction of all fill and backfill shall meet or exceed the following percentages of Standard Proctor Density (ASTM D698):

1. 98 percent below footings.
2. 98 percent below building floor slabs.
3. 95 percent below steps and exterior slabs on grade.
4. 95 percent for backfill placed more than three (3') feet below final pavement subgrades.
5. 100 percent for backfill within upper three (3') feet of final pavement subgrades.
6. 85 percent within landscape areas.

B. Tests falling below the specified density shall be cause for rejection and will require further compacting or removal and recompacting at the Contractor's expense until the Specification requirements are met. Each lift must be approved before commencing with the next succeeding lift.

3.11 ROUGH GRADING

A. The grades shown on the Drawings are proposed finish grades. The Contractor shall grade to the prescribed subgrade elevations except in landscaped areas, which shall be graded to finish grade with approved topsoil.

B. The Contractor shall be solely responsible for determining quantities of fill and waste materials to be handled and for amount of grading to be done in order to completely perform all work indicated on the Drawings. The costs of importing fill and/or exporting excess materials from the site shall be considered part of the Base Bid Contract.

C. Provide surfaces free of debris and building materials. Complete rough grading by blading to reasonably smooth contours with neat, uniform transitions and slopes. Remove stones over two (2") inches diameter, branches and other vegetation. Ease new grades into surrounding existing grades without awkward or abrupt transitions.

D. All surfaces shall be finished to such contour that they will not impound surface water.

1. Rough grade tolerances are as follows:
   a. Unpaved areas outside buildings: Not more than two-tenths (0.20') feet above or below finish grade elevations shown on the drawings.
   b. Building and paved areas: Surfaces shall not vary by more than five one-hundredths (0.05') foot above or one-tenth (0.10') foot below the subgrade elevations referenced to herein.

E. Protect newly graded areas from traffic and erosion. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.

3.12 SUB-GRADE TREATMENT

A. Compact and shape the subgrade for its entirety as may be necessary to produce, at the time base is placed, the specified density and stability in the top twelve (12") inches of the subgrade and the grades indicated on the Drawings.

B. The subgrade shall be compacted with approved equipment to a minimum relative density of 100 percent Standard Proctor Density (ASTM D698).

C. All building areas and areas to be paved shall be brought to within five one-hundredths
(0.05) feet of subgrade elevations and cross sections.

D. The required subgrade stability shall be such that during placement of the base, rutting and displacement does not occur. Maximum yield: One (1") inch (measured from the top of the constructed subgrade to the bottom of the rut).

E. All proposed pavement subgrades shall be test rolled as directed by the Geotechnical Engineer, immediately prior to placement of aggregate base course.

F. If test rolling shows any area to be unstable, the Contractor shall, at his/her expense, scarify the area and aerate or add moisture to the soil as necessary, and recompact the soil to the extent it will be stable when retested by rolling.

G. All pavement areas shall be test rolled in the presence of the Geotechnical Engineer.

3.13 FIELD QUALITY CONTROL

A. Retain the services of a Registered Land Surveyor to prepare a grade verification survey as required in Part 1 General - 1.05 Quality Assurance. This surveyor shall check the subbase elevation after the utilities are installed.

1. Centerline of streets and drives at fifty (50') foot intervals and slope change locations.
2. Parking lots on a seventy-five (75') foot grid and slope change locations.
3. Landscape areas on a seventy-five (75') foot grids and slope change locations.
4. The surveyor shall supply a letter certifying that the grades are within the specified tolerance range.

B. Field-testing and inspection shall be performed by qualified parties as specified herein and in accordance with the provisions of Division One Specifications.

C. Conventional testing and inspection services herein describe those items not specifically required by the City of Birmingham Building Code, but are considered essential to the proper performance of the building systems.

D. Verify that footing bearing surfaces comply with frost depth requirements and report variances in a timely manner.

E. Classification of materials used and encountered during construction will be performed in accordance with ASTM D2488 and D2487.

1. Inspect each footing and slab subgrade to determine if subgrade materials are acceptable. Perform hand auger borings, soil classifications and dynamic cone penetrometer tests to verify if design-bearing capacity is achieved.
2. Inspect, test and approve excavated soils to be used as backfill materials under buildings and site improvements.
3. Inspect and test backfill operations to insure acceptability of materials being placed, method of placement, thickness of layers and compaction of backfill.
4. Inspect and test backfill operations along foundation walls to insure acceptability of materials being placed and compacted so that settlement will not occur.

F. The geotechnical testing laboratory shall advise the Owner, Contractor and Engineer of any materials or operation that in their professional opinion will not produce the specified results. The geotechnical testing laboratory shall perform the following:

1. Observe and evaluate the soil conditions at the bottom of all excavations, determine limits of excavation where applicable and evaluate and document depth and width.

G. Perform analysis for on-site and borrow soils for suitability as backfill.
1. Observe, evaluate and report contractor’s operations within context of soil limitations and project requirements.
2. Perform density tests on compacted backfill materials.
3. Compaction testing will be performed in accordance with ASTM D698.
4. Observe all subgrades and excavation bases below footings and slabs before further construction is performed.

H. If tests indicate that the Work does not meet the specified requirements, remove the Work, replace and retest at no cost to the Owner.

I. Frequency of Tests:

1. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one (1) test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to the Architect/Engineer.
2. Compaction tests of subgrade shall be made at maximum horizontal intervals of fifty (50’) feet in each direction, or as directed by Architect/Engineer.
3. Compaction tests of in-place backfill materials shall be made at a maximum vertical interval of one foot, zero inch (1’ - 0”), and maximum horizontal intervals of fifty (50’) feet in each direction, or as directed by the Architect/Engineer.

END OF SECTION
SECTION 02322 - EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES

PART 1  GENERAL

1.01 SECTION INCLUDES

A. Excavation of trenches for installation of utilities.
B. Backfilling trenches with bedding material as specified and filling trenches with suitable material to proposed subgrade.
C. Compacting backfill materials in acceptable manner.
D. Borings and casings under roads.

1.02 RELATED SECTIONS

A. Section 02220 – Site Demolition
B. Section 02300 - Earthwork
C. Section 02340 - Soil Stabilization
D. Section 02510 - Water Distribution Systems
E. Section 02535 - Sanitary Sewer Systems
F. Section 02536 - Sewer Manholes, Frames, and Covers
G. Section 02630 - Storm Drainage
H. Section 02325 - Aggregate Materials
I. Section 16510 – Site Lighting
J. Construction Drawings

1.03 REFERENCE STANDARDS

A. Jefferson County Environmental Services Department Standards for Construction of Commercial and Residential Sanitary Sewer Systems
B. See Related Sections.

1.04 QUALITY ASSURANCE

A. An independent testing laboratory will perform testing at intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill and furnish copies of results as specified herein.
B. Testing shall be in accordance with Part 3, Section 3.07, “Field Quality Control”.

1.05 SUBMITTALS
A. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to Construction Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.

B. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

C. Submit 30-pound sample of each type of off-site fill material that is to be used in backfilling in air-tight container(s) to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

1.06 PROJECT RECORD DOCUMENTS
A. Accurately record actual locations of subsurface utilities, structures, and obstructions installed or encountered.

PART 2 PRODUCTS

2.01 MATERIALS
A. Bedding Material: For sanitary sewers, bedding material shall be as specified by Jefferson County Environmental Services. For other utilities, aggregate Type as indicated on the plans and as specified in Section 02325.

B. Haunching Material: For sanitary sewers, haunching material shall be as specified by Jefferson County Environmental Services. For other utilities haunching material shall be as specified in Section 02325. Aggregate Type as indicated on the plans and as specified in Section 02325.

C. Backfill material from the site as specified in Section 02300 and approved by Owner.

D. Backfill material from off-site as specified in Section 02300 and approved by Owner.

E. Steel Casing Pipe: Comply with ASTM A 252, Grade 2 with minimum wall thickness of 0.250”. Casing pipe shall be coated inside and out with at least one shop coat of an approved primer paint. In addition, the external surface shall be treated with one coat of asphaltum paint.

F. Backfill material shall not contain rock or stone with a maximum size greater than 2 inches.

2.02 LOCATOR TAPE
A. Detectable warning tape shall be acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6” wide and, 4 mils thick, continuously inscribed with a description of the utility with metallic core encased in a protective jacket for corrosion detection, detectable by metal detector when tape is buried up to 30” deep. Color of tape shall be as follows: Natural Gas or Propane - Yellow, Electric - Red, Telephone and other communications – Orange, Water – blue, Sewer - Green.

2.03 EQUIPMENT
A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.
PART 3   EXECUTION

3.01 PREPARATION

A. Set lines, elevations, and grades for proposed systems.

B. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

C. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on Construction Drawings.

D. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on Construction Drawings.

E. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or additional bedding material placed and compacted as specified in Section 02340.

F. Provide dewatering systems as required for utility excavations. Dewatering systems shall comply with requirements of Section 02300.

3.02 EXCAVATION

A. Contract local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point-bearing. Over excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.

B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25-feet in trenches 4-feet or deeper.

C. Perform excavation as indicated on Construction Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.

D. Remove excavated materials not required or not suitable for backfill or embankments and waste off-site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 02220.

E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified in Section 02300.

F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.
G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.

H. Trench width below top of pipe shall not be less than 12-inches or more than 18-inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.

I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:

1. Water Mains: 36-inches to top of pipe barrel or 6-inches below frost line, established by local building official, whichever is deeper.
2. Sanitary Sewer: Elevations and grades as indicated on Construction Drawings.
3. Storm Sewer: Elevations and grades as indicated on Construction Drawings.
4. Electrical Conduits: 24-inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
5. TV Conduits: 18-inches minimum to top of conduit or as required by local utility company, whichever is deeper.
6. Telephone Conduits: 18-inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
7. Gas Mains and Service: 30-inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

J. For sanitary sewers, trench in accordance with standard drawings and requirements established by Jefferson County Environmental Services.

3.03 PIPE BEDDING

A. Accurately cut trenches for pipe or conduit that is to be installed to designated elevations, 4-inches below bottom of pipe and to the width as specified herein. Place 4-inches of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel.

B. Where required after repeated failure, stabilize subgrade in accordance with Section 02340.

C. For sanitary sewers, bed in accordance with standard drawings and requirements established by Jefferson County Environmental Services.

3.04 BACKFILLING

A. Criteria: Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities. Backfill trenches per compaction requirements and as specified in Sections 02300. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified herein, to properly correct the condition in an acceptable manner.

B. Backfilling: After pipe or conduit has been installed, bedded, and tested as required, backfill trench or structure excavation with specified material placed as given in the Construction Documents.

C. Backfill trenches to contours and elevations shown on Construction Drawings with unfrozen materials.
D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

E. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade except 6” below subgrade under pavement and slabs.

3.05 COMPACTION

A. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

B. Maintain optimum moisture content of fill materials as specified in Section 02300 to attain required compaction density.

C. Materials used for backfill shall comply with requirements of Section 02325 and as specified herein.

3.06 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

A. When indicated by Construction Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.

B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 95 percent of maximum density, in accordance with ASTM D1557 obtained at optimum moisture as determined by AASHTO T 180. Mechanical tampers may be used after cover of 6-in. has been obtained over top of barrel of pipe.

C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2-inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.

D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks at no additional cost to Owner. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area at no additional cost to Owner.

E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt in accordance with area specifications and governing authorities.

F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206 and AWS D7-0-62.

G. Install casing and utility pipe with casing spacers, end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.07 FIELD QUALITY CONTROL

A. See Section 02300, “Field Quality Control”.

END OF SECTION 02322
SECTION 02325- AGGREGATE MATERIALS

PART 1    GENERAL

1.01 SECTION INCLUDES
   A. Aggregate materials for use as specified in other Sections.

1.02 RELATED SECTIONS
   A. Section 02220 – Site Demolition
   B. Section 02030 - Site Clearing
   C. Section 02300 - Earthwork
   D. Section 02321 - Excavation, Backfill, and Compaction for Utilities.
   E. Section 02340 - Soil Stabilization
   F. Section 02370 - Erosion Control and Sedimentation

1.03 REFERENCE STANDARDS
   A. American Society for Testing and Materials (ASTM) latest edition
      2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN.m/m$^3$))
      3. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$ (2,700 kN.m/m$^3$))
      4. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
      5. D 2487 Classification of Soils for Engineering Purposes
      6. D 2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
      7. D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
      8. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   B. American Association of State Highway and Transportation Officials (AASHTO) latest editionT 88
      Particle Size Analysis of Soils

1.04 QUALITY ASSURANCE
   A. Tests and analysis of aggregate materials will be performed in accordance with ASTM and
      AASHTO procedures specified herein.

1.05 SUBMITTALS
   A. Submit 30-pound sample of each aggregate or mixture that is to be incorporated into project in airtight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be incorporated into project to the independent testing laboratory for review.
B. Submit name of each material supplier and specific type and source of each material. Any change in source requires approval of Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Construction and materials shall meet or exceed requirements of this Section and applicable ALDOT standards and specifications section(s) referred to or noted on the Construction Drawings which pertain to paving base course design, materials, preparation, and execution. Materials shall be as indicated on Construction Drawings and shall comply with state highway department specifications regarding source, quality, gradation, liquid limit, plasticity index, and mix proportioning.

B. Soil Materials

1. Subsoil Type S1: Excavated and reused material, graded, free of lumps or rocks larger than 3 inches and debris. As a minimum, all aggregate materials shall meet the following minimum characteristics; Liquid Limit less than 50, Plasticity Index less than 30, Maximum dry density (ASTM D-698) greater than 100 pcf.

2. Subsoil Type S2: Imported material graded, free of lumps and rocks larger than 3 inches, and debris. As a minimum, all aggregate materials shall meet the following minimum characteristics; Liquid Limit less than 50, Plasticity Index less than 30, Maximum dry density (ASTM D-698) greater than 100 pcf.

3. Topsoil Type S3: Excavated and reused material, graded, free of root, rock larger than ½ inch, subsoil, debris, large weeds and foreign matter; conforming to ASTM D2487 Group Symbol OH

C. Aggregate Material

1. Granular Backfill for Retaining Walls: Granular backfill material conforming to ASTM D2487 Group GW, SW, GP or SP or either #57 or #67 stone, all with a minimum unit weight of 125 pcf.

2. Aggregate Base for Pavements: Material shall be dense graded aggregate base stone in accordance with ALDOT Specification Section 825 (B).

3. Aggregate Bedding for Water Mains, Sanitary Sewers and Storm Sewers: Material shall be #57 stone with a minimum unit weight of 125 pcf.

4. Fine Aggregate (Sand) – Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136 and D2487; within the following limits:

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<thead>
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<th>Sieve Size</th>
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<td>7-40</td>
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<td>No. 200</td>
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</table>
2.02 EQUIPMENT

A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger any improvements by rutting, overloading, or pumping.

PART 3 EXECUTION

3.01 STOCKPILING

Stockpile on-site in such manner that there will be no standing water or mixing with other materials.

3.02 BORROW AND SPOIL SITES

Upon completion of borrow and/or spoil operations, clean up borrow and/or spoil areas as indicated on Construction Drawings in neat and reasonable manner to satisfaction of property owner and Owner.

END OF SECTION 02325
SECTION 02340 - SOIL STABILIZATION

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Excavation, treatment, and backfilling of subgrade for lime stabilization.
B. Excavation, treatment, and backfilling of subgrade for cement stabilization.
C. Excavation, treatment, and backfilling of subgrade for fly ash stabilization.
D. Excavation, treatment, and backfilling of subgrade for bridge lift stabilization.
E. Installation of Geotextile Fabric for stabilization of subgrade.

1.02  RELATED SECTIONS

A. Section 02300 - Earthwork
B. Section 02322 - Excavation, Backfill, and Compaction for Utilities
C. Section 02325 - Aggregate Materials

1.03  REFERENCE STANDARDS

A. American Society for Testing Materials (ASTM) latest edition
   1. C 150 Portland Cement
   2. C 618 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
   3. C 977 Quicklime and Hydrated Lime for Soil Stabilization
   4. D 1633 Compressive Strength of Molded Soil-Cement Cylinders
B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
   1. M 216 Lime for Soil Stabilization
C. National Lime Association (NLA)

1.04  ENVIRONMENTAL REQUIREMENTS

A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees Fahrenheit.

1.05  QUALITY ASSURANCE

A. Perform work in accordance with state and local standards in conjunction with requirements specified herein.

1.06  SUBMITTALS

A. Submit 30-pound sample of each material to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of material that is to be used to the independent testing laboratory for review.
B. Submit name of each materials supplier and specific type and source of each material. Change in source requires approval of Owner.

C. Submit mix design and materials mix ratio that will achieve specified requirements of state and local agencies for soil stabilization.

PART 2  PRODUCTS

2.01 MATERIALS
A. Hydrated Lime
B. Portland Cement: ASTM C150, Normal Type I
C. Fly Ash: ASTM C977 or AASHTO M216
D. Surge Stone

2.02 ACCESSORIES
A. Curing Seal: Asphalt Emulsion Primer
B. Geotextile Fabric for Stabilization
   1. Mirafi 500X or 600X
   2. Phillips 66 Supac 6WS
   3. Dupont Typar 3401 and 3601
   4. Trevira S1114 and S1120
   5. Tensar SS-1 and SS-2
   6. Exxon GTF-200 or 350
   7. TerraTex HD and GS
   8. Approved Alternate

2.03 EQUIPMENT
A. Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting of material.

PART 3  EXECUTION

3.01 PREPARATION
A. Obtain approval from the independent testing laboratory for the type of stabilization method to be used and/or mix design before proceeding with placement.
B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.
C. Proofroll subgrade to identify areas in need of stabilization.

3.02 EXCAVATION
A. Excavate subsoil to depth sufficient to accommodate soil stabilization.
B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.
C. Do not excavate within normal 45 degree bearing splay of any foundation.

D. Notify owner and civil engineering consultant of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.

E. Correct areas over-excavated in accordance with Section 02300.

F. Remove excess excavated material from site.

3.03 GEOTEXTILE FABRIC

A. Place geotextile fabric over subsoil surface, lap edges and ends in accordance with manufacturer's recommendations in those areas that need additional stabilization prior to placement of base course. Bridge lift sections may require the use of geotextile fabric for stabilization prior to placement of fill.

B. Place geotextile fabric in accordance with manufacturer's recommendations.

3.04 SOIL TREATMENT AND BACKFILLING

A. Lime Stabilized Subgrade: Where required after continual failure, treat prepared subgrade with hydrated lime in accordance with state highway department specifications.

B. Cement Stabilized Subgrade: Where required after continual failure, treat prepared subgrade with portland cement in accordance with state highway department specifications.

C. Fly Ash Stabilized Subgrade: Where required after continual failure, treat prepared subgrade with fly ash in accordance with state highway department specifications.

D. Bridge Lifts: Where required after continual failure, treat prepared subgrade by application of a bridge lift. Bridging over existing soils shall be acceptable only when approved in writing by the Owner. Place geotextile fabric or geogrid over existing soils to be bridged. The geotextile fabric or geogrid selected shall be appropriate for the bridge lift material being placed. Place bridge lift over geotextile fabric or geogrid. Bridge lift material may be surge stone, granular fill, or shot rock fill. Granular material shall be in accordance with Section 02325. Surge stone and shot rock will be approved by the Owner's representative on a submittal basis. The Owner and the Owner's representative shall have sole discretion as to the acceptability of all submittals.

E. Backfill and compaction of treated subsoil shall be in accordance with Sections 02300 and 02322.

F. Maintain optimum moisture of mixed materials to attain required stabilization and compaction.

G. Finish subgrade surface in accordance with Section 02300.

H. Remove surplus mix materials from site at no additional cost to the Owner.

3.05 CURING

A. Immediately following compaction of mix, seal top surface with curing seal.

B. Do not permit traffic for 72 hours after sealing top surface.

3.06 FIELD QUALITY CONTROL

A. Compression test and analysis of hardened fill material will be performed in accordance with Section 02300.
B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

END OF SECTION 02340
SECTION 02361 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Soil treatment with termiticide.
   2. Application below grade and at interior and exterior foundation perimeter.

1.2 SCOPE
A. Furnish and install a chemical barrier to afford the structure protection from termites and other common ground insects.
B. Comply with all applicable regulatory and environmental requirements.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include the EPA-Registered Label for termiticide products.
B. Product certificates.
C. Soil Treatment Application Report: Include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.
B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
C. Preinstallation Conference: Conduct conference at [Project site]
1.5 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: [Five] years from date of Substantial Completion.

2. At the end of the five year period, the Owner shall be offered a renewable contract (guarantee) on a year-by-year basis, at the Owner's option, at an agreed upon annual fee.

1.7 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide [12 months'] continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following]:

   a. BASF Corporation, Agricultural Products; Termidor.
   b. Bayer Environmental Science; Premise 75.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than [five] years against infestation of subterranean termites.
PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.2 APPLYING SOIL TREATMENT

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

   1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

D. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

   1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
   2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
   3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
   5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

E. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

F. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

G. Post warning signs in areas of application.
H. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION
SECTION 02370 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Installation of temporary and permanent erosion control systems.

B. Installation of temporary and permanent slope protection systems.

1.02 RELATED SECTIONS

A. Section 02030 - Site Clearing

B. Section 02300 – Earthwork

C. Section 02630 – Storm Drainage

D. Section 02930 – Landscape Work

E. Storm Water Pollution Prevention Plan

F. Construction Drawings

1.03 REFERENCE STANDARDS


1.04 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent properties and water resources from erosion and sediment damage throughout life of contract.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Quick growing grasses such as wheat, rye, or oats in accordance with the Drawings.

B. Silt socks for siltation control as specified on the Drawings.

C. Fencing for siltation control as specified on Construction Drawings and the Alabama Handbook.

D. Curlex blankets by American Excelsior Company or approved equal.
E. Temporary mulches such as loose hay, straw, netting, wood cellulose, or agricultural silage.

F. Fence stakes shall be metal, shall be minimum of 5-ft in length and shall be driven 1'-6" into ground.

G. Rip-Rap in accordance with the Drawings.

I. Temporary and Permanent Outfall Structures as specified on Construction Drawings.

J. Slope reinforcement mat, North American Green.

PART 3 - EXECUTION

3.01 PREPARATION

A. Review Construction Drawings and Storm Water Pollution Prevention Plan.

B. Conduct pre-construction meeting with Site Contractor.

3.02 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION

A. Place erosion control systems in accordance with Construction Drawings and Storm Water Pollution Prevention Plan or as may be dictated by site conditions in order to maintain the intent of the specifications and permits at no additional cost to Owner.

B. Deficiencies or changes on Construction Drawings or Storm Water Pollution Prevention Plan shall be implemented as site conditions change.

C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.

D. Maintain temporary erosion control systems as directed by Owner or governing authorities to control siltation during life of contract. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities within 48 hours or sooner if required at no additional cost to the Owner.

E. Contractor will be required to incorporate permanent erosion control features into project at earliest practical time to minimize need for temporary controls.

F. Permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.

G. Slopes that erode easily or that will not be graded for a period of 14 days or more shall be temporarily seeded as work progresses with wheat, rye, or oats application as specified on the Construction Drawings.

H. Slopes 3H:1V and flatter shall be stabilized with slope mat by North American Green, C125.
I. Slopes 3H:1V and steeper shall be stabilized with slope mat by North American Green, C350.

END OF SECTION 02370
SECTION 02510 - WATER DISTRIBUTION SYSTEMS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Site water piping and fittings including domestic potable waterline and fire protection system supply waterline, valves, and fire hydrants.

B. Connection of site water system to existing water systems.

1.02  RELATED SECTIONS

A. Section 02322 - Excavation, Backfill, and Compaction for Utilities

B. Construction Drawings

1.03  REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME) latest edition
  1. B 16.22  Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

B. American Society for Testing and Materials (ASTM) latest edition
  1. B 88  Seamless Copper Water Tube
  2. D 1784  Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
  3. D 2241  Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
  4. D 2564  Poly (Vinyl Chloride) (PVC) solvent cement
  5. D 2672  Poly (Vinyl Chloride) (PVC) integrally molded bell ends for solvent-cemented pipe joints.
  6. D 2855  Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
  7. D 3139  Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
  8. F 477  Elastomeric gaskets and lubricant
  9. F 656  Poly (vinyl chloride) (PVC) cement Primer

C. American National Standards Institute (ANSI) latest edition
  1. A21.8

D. American Water Works Association (AWWA) latest edition
  1. C104  Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
  2. C105  Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
  3. C110  Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches, for Water and Other Liquids
  4. C111  Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
  5. C151  Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
  6. C200  Steel Water Pipe 6 Inches and Larger
  7. C500  Gate Valves for Water and Sewage Systems
  8. C502  Dry-Barrel Fire Hydrants
  9. C504  Rubber-Seated Butterfly Valves
  10. C600  Installation of Ductile-Iron Water Mains and Appurtenances
  11. C606  Grooved and Shouldered Joints
  12. C651  Disinfecting Water Mains
13. C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water Distribution

E. National Fire Protection Associations (NFPA)
   1. NFPA 13 Installation of Sprinkler Systems
   2. NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances

F. The Water Works and Sewer Board of the City of Birmingham, Alabama pamphlet on Backflow Prevention and Cross Connection Control

1.04 QUALITY ASSURANCE

A. Perform installation in accordance with utility company or municipality requirements.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Perform disinfection of potable lines in accordance with AWWA C651.

1.05 SUBMITTALS

A. Product Data: Provide CEC with data on pipe materials, pipe fittings, hydrants, valves, and accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

C. Furnish 1 copy of results of meter test and hydrostatic pressure test to Owner and utility company upon completion of water distribution backfilling operations.

D. Project Record Documents:
   1. Disinfection report; record:
      a. Type and form of disinfectant used.
      b. Date and time disinfectant injection start and time of completion.
      c. Test locations.
      d. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
      e. Date and time of flushing start and completion.
      f. Disinfectant residual after flushing in ppm for each outlet tested.
   2. Bacteriological report; record:
      a. Date issued, project name, testing laboratory name, address, and telephone number.
      b. Time and date of water sample collection.
      c. Name of person collecting samples.
      d. Test locations.
      e. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
      f. Coliform bacteria test results for each outlet tested.
      g. Certification that water conforms, or fails to conform, to bacterial standards.
      h. Bacteriologist’s signature and authority.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of piping mains, valves, connections, and top of pipe elevations.

B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.
PART 2  PRODUCTS

2.01 PIPE

A. Pipe sizes less than 3-inches that are installed below grade and outside building shall comply with the following:
   1. Seamless Copper Tubing: Type “K” soft copper, ASTM B 88.
      a. Fittings: Wrought copper (95-5 Tin Antimony solder joint), ASME B 16.22.

B. Pipe sizes 3-inches and larger that are installed below grade and outside building shall comply with the following:
   1. Potable water line shall be Ductile Iron Water Pipe: AWWA C151, pressure class 350.
      a. Fittings: Mechanical joint meeting AWWA C110 or AWWA C111.
   2. Non-potable water line shall be Polyvinyl Chloride (PVC) Water Pipe: Pipe, AWWA C900, rated DR 18 (Class 150), continually marked as required.
      c. Trace wire: Magnetic detectable conductor, (#12 Copper) brightly colored plastic covering imprinted with “Water Service” in large letters.

2.02 GATE VALVES - 2-Inches and Larger

A. Manufacturers: Mueller Resilient Seat Gate Valves or approved equal.

B. AWWA C509, Ductile iron body, non-rising stem with square nut, single wedge, resilient seat, class 200 flanged or mechanical joint ends, control rod, post indicator where indicated on Construction Drawings, extension box and valve key. Interior coating shall comply with AWWA C550.

2.03 BALL VALVES - 2-Inches and Smaller

A. Manufacturers: Mueller Oriseal or approved equal.

B. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA compression inlet end, compression outlet with electrical ground connector, with control rod, extension box and valve key.

2.04 BUTTERFLY VALVES - from 2-Inches to 24-Inches

A. AWWA C504, Iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

2.05 BACKFLOW PREVENTORS

A. Reduced Pressure Zone Backflow Preventers: Reduced pressure zone backflow preventers shall be as approved by and installed per the Birmingham Water Works Board and shall meet the latest standards of ASSE #1048 and AWWA #C-5108, FM, UL Classified and tested and certified under USC’s Foundation for Cross-Connection Control and Hydraulic Research.

B. Double Check Backflow Preventors: Double check backflow preventors shall be as approved by and installed per the Birmingham Water Works Board and shall meet the latest standards of ASSE #1015 and AWWA #C-510, FM, UL Classified and tested and certified under USC’s Foundation for Cross-Connection Control and Hydraulic Research.
2.06 FIRE HYDRANTS
A. Fire Hydrants: Type as required by utility company/Local Fire Department and as shown on Construction Drawings.
B. Hydrant Extensions: Fabricate in multiples of 6-inches with rod and coupling to increase barrel length.
C. Hose and Steamer Connections: Match sizes with utility company, with two hose nozzles, one pumper nozzle.
D. Finish: Apply primer and 2 coats of enamel or special coating to color as required by utility company.

2.07 PRESSURE REGULATING VALVES
A. Subject to compliance with requirements, provide products by Cash Acme, Conbraco, Honeywell Water Controls, Watts Water Technologies, Zurn Plumbing Products Group or approved alternate. Pressure regulator shall have a bronze body for sizes 2” and smaller and cast iron for sizes greater than 2”. Pressure regulators shall comply with ASSE 1003.

2.08 FREEZE-PROTECTION ENCLOSURE
A. Subject to compliance with requirements, provide products by Aqua Shield, BF Products, Inc., DekoRRa Products, Dunco Manufacturing, Inc., G & C Enclosures, Hot Box, Inc. HydroCowl, Inc., Watts Water Technologies or approved alternate.
B. Insulated enclosure shall be designed to protect above ground water piping equipment or specialties from freezing and damage with heat source to maintain internal temperature of 40 deg F when external temperatures reach as low as 34 deg F. Enclosure shall comply with ASSE 1060.
C. Enclosure shall be of reinforced aluminum or fiberglass and of dimensions required by protected unit. Provide drain opening, access doors with locking device and anchoring device for attaching to concrete base. Provide electric cable or heater with self-limiting temperature control

2.09 ACCESSORIES
A. Thrust Blocking: Place 3000 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 pounds per square foot when water main pressure is 100 psi.

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B. Locked mechanical joint fittings shall be installed where vertical changes in direction are required and, if approved by Owner and governing authority, can be installed in lieu of above thrust blocking requirements.

C. Vaults, meter and valve boxes shall be provided for all water appurtenances. They shall be rated for H-20 traffic loading and shall be consistent with and installed per Birmingham Water Works Board requirements. The word “WATER” shall be cast into the cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connections and water main size, location, and depth are as indicated on Construction Drawings.

3.02 PREPARATION

A. Ream pipe and tube ends and remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare pipe for connections to equipment with flanges or unions.

D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.03 BEDDING

A. Excavate pipe trench and place bedding material in accordance with Section 02322 and Construction Drawings.

3.04 INSTALLATION - PIPE AND FITTINGS

A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state or local codes.

B. Install pipe and fittings in accordance with AWWA C600.

C. Install pipe to allow for expansion and contraction without stressing pipe or joints or as specified by pipe manufacturer.

D. Install access fittings in accordance with local codes to permit disinfection of water system performed under this Section.

E. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions with least interference with operation of existing pipeline and in compliance with local utility company.

F. Form and place concrete for thrust blocks or other specified methods of retainage at each change of direction or end of pipe main.

G. Establish elevations of buried piping in accordance with Section 02322.
H. Backfill trench in accordance with Section 02322.

I. Install detectable warning tape continuous over top of pipe. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade except 6” below subgrade under pavement and slabs.

3.05 INSTALLATION - VALVES AND HYDRANTS

A. Install gate valves as indicated on Construction Drawings. Support valve on concrete pads with valve stem vertical and plumb. Install valve boxes in manner that will not transmit loads, stress, or shock to valve body. Center valve box over operating nut of valve vertical and plumb. Securely fit valve box together leaving cover flush with finished surface.

B. Install fire hydrant assemblies as indicated on Construction Drawings in vertical and plumb position with steamer/pumper nozzle pointed perpendicular to traffic where hydrant is adjacent to street, roadway, or parking lot drive or toward protected building unless otherwise directed by local authorities. Support hydrant assembly on concrete pad and firmly brace on side opposite inlet pipe against undisturbed soil and concrete blocking. Place minimum of 6-cubic feet of crushed stone or gravel around hydrant base and barrel after thrust blocking has cured at least 24 hours. Exercise care when backfilling and compacting so proper vertical position will not be altered.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Contractor to disinfect distribution system with chlorine before acceptance for domestic operation. Amount of chlorine shall be such as to provide dosage of not less than 50 parts per million. Thoroughly flush lines before introduction of chlorinating materials and after contact period of not less than 24 hours, system shall be flushed with clean water until residual chlorine content is not greater than 1.0 part per million. Open and close valves in lines being disinfected several times during contact period. After disinfection, take water sample and bacteriologically test in accordance with AWWA C651. Do not place distribution system in service until approval is obtained from local governing authorities.

B. Contractor shall provide a means of neutralizing the super-chlorinated water before releasing into the environment. This may be accomplished by either a method of dechlorinization, direct release into a detention area, or any method acceptable to federal, state, and local codes. Direct release to open ground shall not be allowed, unless contained within an on site detention facility with 6” permanent storage. In this case, the contractor shall time the release to assure that no rainstorms are imminent. The intent of this condition is to allow the majority of the chlorine to evaporate into the atmosphere before a rainstorm has the opportunity to wash the residual downstream. Contractor shall not release super-chlorinated water directly into the sanitary sewer system, private or public, nor any storm drain system not directly discharging into the detention facility mentioned above.

3.07 SERVICE CONNECTIONS

A. Provide water service connection in compliance with utility company requirements including reduced pressure backflow preventor (if required) and water meter with by-pass valves and sand strainer.

3.08 FIELD QUALITY CONTROL

A. Perform compaction testing of trench backfill in accordance with Section 02322.
B. Test water distribution system pipe installed below grade and outside building in accordance with the following procedures:

1. Perform testing of pipe materials, joints, and other materials incorporated into construction of water mains and force mains to determine leakage and water tightness. Test pressure pipeline in accordance with Section 4 of AWWA C600 and NFPA 24. In the event state or local code requires more stringent test, more stringent test shall take precedence.

2. Pressure Test: After pipe has been laid, subject newly laid pipe or valved section to hydrostatic pressure of at least 1.5 times working pressure at point of testing and not less than 1.25 times working pressure at highest point along test section.

3. Leakage Test: Conduct leakage test concurrently with pressure test. Leakage is defined as quantity of water that must be supplied into newly laid pipeline or valved section thereof to maintain pressure within 5 psi of specified test pressure after air in pipeline has been expelled and pipeline has been filled with water. Leakage shall not be measured by drop in pressure in test section over period of time.
   a. Pipeline installation will not be accepted if leakage is greater than that determined by the following formula:

   \[
   L = \frac{SD\sqrt{P}}{133200}
   \]

   \(L\) = allowable leakage, (gallons per hour)
   \(S\) = length of pipe tested, (feet)
   \(D\) = nominal diameter of pipe, (inches)
   \(P\) = average test pressure during test, (psig)

4. Visible Leakage: Repair visible leaks regardless of amount of leakage measured.

5. Acceptance of Installation: If test of pipe laid in place discloses leakage greater than that specified, Contractor shall, at his own expense, locate leak and make repairs as necessary until leakage is within specified allowance. Supply water for testing at no expense to Owner.

END SECTION 02510
SECTION 02535 - SANITARY SEWAGE SYSTEMS

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Sanitary sewer drainage piping, fittings, accessories, cleanouts, and bedding.
B.  Connection of site sanitary sewer system to municipal sanitary sewer systems.

1.02  RELATED REQUIREMENTS

A.  Section 02322 - Excavation, Backfill, and Compaction for Utilities
B.  Section 02536 - Sewer Manholes, Frames, and Covers
C.  Construction Drawings

1.03  REFERENCE STANDARDS

A.  American Society for Testing and Materials (ASTM) latest edition
   1.  A74  Cast Iron Soil Pipe and Fittings
   2.  A746  Ductile Iron Gravity Sewer Pipe
   3.  C12  Practice for Installing Vitrified Clay Pipe Lines
   4.  C150  Portland Cement
   5.  C207  Hydrated Lime for Masonry Purposes
   6.  C425  Compression Joints for Vitrified Clay Pipe and Fittings
   7.  C478  Precast Reinforced Concrete Manhole Sections
   8.  C564  Rubber Gaskets for Cast Iron Soil Pipe and Fittings
  10.  C828  Recommended Practice for Low-Pressure Air Test of Vitrified Clay Pipe Lines
  11.  D1785  Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
  12.  D2141  Poly (vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
  13.  D2657  Heat-Joining Polyolefin pipe and Fittings
  14.  D3034  Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  15.  D3035  Polyethylene (PE) Plastic Pipe Using Flexible Elastomeric Seals
  16.  D3139  Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals
  17.  D3212  Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
  18.  D3261  Butt heat fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic pipe and Tubing
  19.  F477  Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C.  American Water Works Association (AWWA) latest edition
   1.  C111  Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
   2.  C600  Ductile-Iron Water mains and Their Appurtenances
   3.  C900  Polyvinyl Chloride (PVC) Pressure pipe, 4 in. Through 12 in, for Water Distribution
   4.  C901  Polyethylene (PE) Pressure pipe, Tubing and Fittings 1/2 inch through 3 inches, for Water Distribution
   5.  C906  Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch, for Water Distribution

D.  Jefferson County Environmental Services Department Standards for Construction of Commercial and Sanitary Sewer Systems. Where a conflict between these specifications and Jefferson County
1.04 QUALITY ASSURANCE
A. An independent testing laboratory, selected and paid by Owner, will be retained to perform construction testing on site.

1.05 SUBMITTALS
A. Product Data: Provide data of pipe materials, pipe fittings, and accessories.
B. Manufacturer's Certificate: Certify that products meet or exceed specified local requirements.

1.06 PROJECT RECORD DOCUMENTS
A. Accurately record actual locations of pipe runs, connections, cleanouts, and invert elevations.
B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.07 PROJECT CONDITIONS
A. Coordinate work with termination of sanitary sewer connection outside building and connection to municipal sewer utility service.

PART 2 PRODUCTS

2.01 SEWER PIPE, FITTINGS, AND JOINTS

2.02 PIPE ACCESSORIES
A. Pipe Joints: Joints for ductile iron pipe shall be push on type such as Fasttite, Tyton or Super Bell-tite or approved alternate manufactured in accordance with ANSI/AWWA C111/A21.11.
B. Fittings: Fittings for ductile iron pipe shall be ductile iron to conform to ANSI/AWWA C110/A21.10.

2.03 CLEANOUTS AND MANHOLES
A. Precast concrete manholes section shall conform to Section 02536 and Jefferson County Environmental Services standards. Where a conflict arises, Jefferson County Environmental Services standards shall control

B. Lid and Frame: Provide traffic grade and rated covers and frames where cleanouts and manholes are within pavement, with the letters “SSCO” or “SANITARY SEWER” respectively cast into the cover. Manhole covers shall be “bolt down” variety with Jefferson County emblem as detailed by Jefferson County standard drawings.

B. Shaft Construction: Cast Iron shaft of internal diameter as specified on Construction Drawings with 2500 psi concrete collar for cleanouts.
PART 3  EXECUTION

3.01  EXAMINATION

A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Construction Drawings.

3.02  PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with bedding material.
B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.

3.03  BEDDING

A. Excavate trench and place bedding material in accordance with Jefferson County Environmental Services standard details.

3.04  INSTALLATION - PIPE

A. The type and class of pipe used shall be as shown on the construction plans and per Jefferson County Environmental Services standard drawings and specifications. Pipes shall be laid and maintained to the required line and grade with necessary fittings, bends, manholes risers, cleanouts and other appurtenances placed at the required locations. The pipe shall be installed with uniform bearing under the full length of the barrel of the pipe. The pipe shall be inspected for defects and cracks before carefully being lowered into the trench. Any defective, damaged or unsound pipe, or any pipe that has had its grade disturbed after laying shall be taken up and replaced. Commence installation at lowest point with the bell end upgrades.
B. No pipe shall be laid in water or when trench conditions are unsuitable for work.
C. Pipe connecting to manholes or other structures shall terminate flush inside of the structure wall.
D. Joints for PVC and CISP shall be thoroughly lubricated with an approved lubricant before pipe sections are slipped together. Open ends shall be fully protected with a stopper to prevent earth or other material from entering the pipe during construction. Carefully free interior of the pipe from dirt, cement and other deleterious material as the work progresses.
E. Maintain separation of potable water main for sewer piping (10 foot horizontal and 18 inches vertical minimum.
F. Route pipe in straight line parallel to roads, buildings and adjacent utilities and as shown on construction drawings.
G. Establish elevations of buried piping with sufficient cover as recommended by pipe manufacturer to ensure not less than 3 feet of cover, except as noted on drawings.
H. Backfill trench in accordance with Jefferson County Environmental Services standard details and Section 02322.
I. Install detectable warning tape continuous over top of pipe. Warning tape shall be continuously placed 300 mm (12 inches) below finish grade except 6” below subgrade under pavement and slabs.
3.05 INSTALLATION – CLEANOUTS AND MANHOLES

A. Form bottom of excavation clean and smooth to correct elevation.

B. For cleanouts form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe to be installed to proper elevations.

C. For manholes construct inverts according to the following guidelines:
   1. Invert channel shall be smooth and accurately shaped to a semicircular bottom to match with the inside of the adjacent sewer section.
   2. Invert channels and structure bottoms shall be shaped with mortar and lean concrete.
   3. Changes in size and grade of invert shall be made gradually and evenly.
   4. Changes in the direction of the sewer entering branch or branches shall have a true curve of as large a radius as the manhole will permit.

D. For manholes provide manhole rings, frame and cover as shown on the construction drawings.

3.06 FIELD QUALITY CONTROL

A. Pipes and joints shall not be completely backfilled until after inspection, testing, and approval by the Jefferson County Sewer Construction Inspector and Construction Manager.

B. Prior to testing for leakage, the pipe trench shall be backfilled to at least the spring line of the pipe. If required to prevent pipe movement during testing, additional backfill shall be added leaving the pipe joints uncovered to permit inspection.

C. Testing of sanitary sewers shall be performed per Jefferson County Environmental Services standards.

F. Provide measuring devices, meters, water, materials, and labor for making the required tests.

G. Tests shall be conducted in the presence of the Jefferson County Sewer Construction Inspector, and the project Construction Manager or his designee. Test data shall be submitted to the Engineer for review and approval.

HI. If deflection test is to be run using a rigid ball or mandrel. It shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.

1. Allowable Deflection: Maximum allowable pipe deflection shall not exceed 5 percent of nominal inside diameter.

2. Mandrel: Mandrel, go/no-go, device shall be cylindrical in shape and constructed with either 9 or 16 evenly spaced arms or prongs. Mandrels with fewer arms will be rejected as not sufficiently accurate. Contact length of mandrel's arms shall equal or exceed nominal inside diameter of sewer to be inspected. Critical mandrel dimensions shall carry tolerance of 0.01-inch maximum. Contractor shall provide mandrel and necessary equipment for mandrel test.

3. Procedure: Mandrel shall be hand-pulled through flexible pipe sewer lines no earlier than 30 days after trench has been completely backfilled. Sections of sewer not passing mandrel shall be uncovered and rebedded, rerounded, or replaced to satisfaction of Owner or governing agency. Repaired section shall be retested.

END OF SECTION 02535
SECTION 02536 – SANITARY SEWER MANHOLES, FRAMES, AND COVERS

PART 1  GENERAL

1.01 SECTION INCLUDES

A. Monolithic concrete manhole barrel with either monolithic concrete or masonry transition to lid frame.

B. Modular precast concrete manhole barrel with tongue-and-groove joints with either precast concrete or masonry transition to lid frame.

C. Preparation and installation of lid frame, covers, anchorage, and accessories.

1.02 RELATED SECTIONS

A. Section 02322 - Excavation, Backfill, and Compaction for Utilities

B. Section 02535- Sanitary Sewer Systems

C. Section 02630 - Storm Drainage

D. Construction Drawings

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition
   1. A 48  Gray Iron Castings
   2. C 55  Concrete Building Brick
   3. C 478 Precast Reinforced Concrete Manhole Sections
   4. C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
   5. D 1248 Polyethylene Plastics Molding and Extrusion Materials

B. International Masonry Industry All-Weather Council (IMIAC) latest edition

C. State Department of Transportation (DOT), Construction and Material Specifications, Latest Edition

D. Jefferson County Environmental Services Department Standards for Construction of Commercial and Sanitary Sewer Systems. Where a conflict between these specifications and Jefferson County Environmental Services Department Standards for Construction of Commercial and Sanitary Sewer Systems occurs, Jefferson County standards shall control.

1.04 SUBMITTALS

A. Shop Drawings: Indicate reference to Construction Drawings of manhole locations, elevations, piping with sizes, locations, and elevations of penetrations.

B. Product Data: Provide data for manhole covers, manhole steps, component construction, features, configuration, and dimensions.
PART 2 PRODUCTS

2.01 MATERIALS

A. Manhole Barrel: Reinforced precast concrete in accordance with Jefferson County Environmental Services standards and ASTM C 478 with gaskets in accordance with ASTM C443. Additionally each joint shall be supplied with Conseal CS-231 water stop sealant as manufactured by Concrete Sealants in widths as recommended by the manufacturer. Flexible manhole sleeves (boots) shall be required for all pipe 18” and smaller. The boot shall be Kor-N-Seal or approved alternate conforming to ASTM - C 923.

1. Construct manholes of precast concrete sections as required by Construction Drawings to size, shape, and depth indicated, but never less than 4’-0” inside diameter.

B. Brick: ASTM C 32, Grade SM of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws and shall have a clear ring when struck together. Nominal modular size shall be 3 3/4-inches x 8-inches x 2 1/4-inches

C. Mortar and Grout: Mortar for finishing and sealing shall be Class "C". Honeycombing less than 2-inches deep shall be repaired using Class "D" mortar.

D. Brick Transition Reinforcement: Formed steel 8-gauge wire with galvanized finish.

2.02 COMPONENTS

A. Lid and Frame: ASTM A 48-83, Class 30 heavy duty cast iron construction rated for H-20 traffic loading, Lids shall be bolt down variety. They shall have the Jefferson County emblem, and shall be model #V-2480 as manufactured by East Jordan Iron Works or approved alternate

B. Manhole Steps: Shall be made of steel reinforced copolymer polypropylene plastic, modelPS1 PF as manufactured by M.A. Industries, Inc., installed at maximum16” intervals.

2.03 CONFIGURATION

A. Barrel Construction: Concentric with concentric cone top section.

B. Shape: Cylindrical

C. Clear Inside Dimensions: 48-inches diameter minimum or as indicated on Construction Drawings.

D. Design Depth: As indicated on Construction Drawings.

E. Clear Lid Opening: 24-inches minimum

F. Pipe Entry: Provide openings as indicated on Construction Drawings

G. Main and Lateral Pipes: Neatly cut off main and lateral pipes flush with inside of manhole or inlet where they enter structure walls. Point up irregularities and rough edges with nonshrinking grout.

H. Inverts: Shape inverts for smooth flow across structure floor as indicated on Construction Drawings. Use concrete and mortar to obtain proper grade and contour. Finish surface with fine textured wood float.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify items specified by other Sections are properly sized and located.
B. Verify that built-in items are in proper location and ready for roughing into work.
C. Verify that the excavation for manholes is correct.

3.02 PREPARATION
A. Coordinate placement of inlet and outlet pipe or duct sleeves as indicated on Construction Drawings.

3.03 PLACING PRECAST MANHOLE BARREL SECTIONS
A. Place compacted gravel pad to proper elevation and location and level surface for placement of manhole base section.

B. Place manhole base section and level to correct elevations.
   1. After completion of gravel foundation, lower base section into position, and set level and plumb on gravel base. Align and adjust to proper grade prior to placing and forming invert. Pour invert immediately after setting of first section of manhole barrel.
   2. Prior to setting subsequent manhole barrel sections, ensure gasket and water stop sealant are properly seated at joint. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.

C. Set cover frames and lids level without tipping, to correct elevations. Utilizing pre-cast rings, or brick and mortar may achieve final rim elevation. Maximum limit, 4 courses.

END OF SECTION 02536
SECTION 02630 - STORM DRAINAGE

PART 1    GENERAL

1.01 SECTION INCLUDES
A. Site storm sewer drainage piping, fittings, accessories, and bedding.
B. Connection of building storm water drainage system to municipal storm sewers.
C. Catch basins, paved area drainage, and site surface drainage.

1.02 RELATED REQUIREMENTS
A. Section 02322 - Excavation, Backfill, and Compaction for Utilities
B. Section 02370 - Slope Protection and Erosion Control
C. Section 02536 - Sewer Manholes, Frames, and Covers
D. Construction Drawings

1.03 REFERENCE STANDARDS
A. American Association of State Highway and Transportation Officials (AASHTO) latest edition
   1. M36 Zinc Coated (Galvanized) Corrugated Iron or Steel Culverts and Under Drains
   2. M190 Bituminous Coated Corrugated Metal Culvert Pipe and Arches
   3. M252 Corrugated Polyethylene Drainage Tubing, 3 to 10 Inch Diameter
   4. M294 Corrugated Polyethylene Drainage Tubing, 12 to 36 Inch Diameter
B. American Society for Testing and Materials (ASTM) latest edition
   1. A74 Cast Iron Soil Pipe and Fittings
   2. A185 Steel welded Wire Fabric, Plain, for Concrete Reinforcement
   3. A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   4. A746 Ductile Iron Gravity Sewer Pipe
   5. C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
   6. C150 Portland Cement
   7. C206 Finished Hydrated Lime
   8. C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
   9. C478 Precast Reinforced Concrete Manhole Sections
   10. C564 Rubber Gasket for Cast Iron Soil Pipe and Fittings
   11. C969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
   12. D 3034 Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
   14. D3350 Polyethylene Plastic Pipe and Fitting Materials
   15. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
C. American Concrete Institute (ACI)
   1. ACI 301 Structural Concrete for Buildings

1.04 SUBMITTALS
A. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide shop drawings for precast inlets, catch basins and junction boxes.

B. Manufacturer's Certificate: Certify that products meet or exceed specified local requirements.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions and location of uncharted utilities.

1.06 PROJECT CONDITIONS

A. Coordinate work with termination of storm sewer connection outside building including connection to municipal storm sewer system.

PART 2 PRODUCTS

2.01 STORM SEWER PIPE MATERIALS AND FITTINGS

A. Reinforced Concrete Pipe (RCP): ASTM C 76, Class III, wall B (Class V under Railroads) except as noted on Construction Drawings, installed with rubber gaskets at joints.

1. Gaskets: Joint material for RCP shall be rubber gasket conforming to the requirements of ASTM C443.

2. Flared end sections shall be class 1

B. Polyvinyl Chloride (PVC) Pipe: Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, rating,

1. Schedule 40 PVC – Type I, Grade I Polyvinyl Chloride (PVC) with a cell classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict accordance with ASTM D1785 and ASTM D2665.

2. Schedule 80 PVC - Type I, Grade I Polyvinyl Chloride (PVC) with a cell classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict accordance with ASTM D1785.

C. Ductile Iron Pipe (DIP): shall be as specified in section 02535, Sanitary Sewer Systems

2.02 INLETS, CATCH BASINS AND JUNCTION BOXES

A. Lid and frame per details shown on Construction Drawings.

B. Structure construction in accordance with details shown on Construction Drawings.

C. Cast-In-Place concrete for drainage structures including: manholes, inlets, catch basins, collars, support blocks, headwalls and paved ditches shall conform to ACI 301 and applicable reference specification therein and the following:

1. Compressive Strength – 4000 psi at 28 days.

2. Reinforcement – ASTM A615, grade 40 or 60 deformed reinforcing bars. Or A185 for wire fabric
D. Cement Mortar used for paving inverts, filling lift holes, joints, patching and anchoring castings shall consist of one part portland cement, type I, ASTM C150, 1/4 part hydrated lime, ASTM C206 and 2-1/2 parts clean, well-graded sand and water free of suspended matter, alkali, and containing no industrial or domestic waste.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on Construction Drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with bedding material.
B. Remove large stones or other hard matter that could damage piping or impede consistent backfilling or compaction.
C. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

3.03 BEDDING

A. Excavate pipe trench and place bedding material in accordance with Construction Drawings and Section 02322.

3.04 INSTALLATION - PIPE

A. The pipe shall be inspected for defects and cracks before being carefully lowered into the trench, piece by piece. Any defective, damaged or unsound pipe or any pipe that has had its grade disturbed after laying shall be taken up and replaced. Open ends shall be protected with a stopper to prevent earth or other material from entering the pipe during construction. The interior of the pipe shall be free from dirt, excess water and other foreign materials as the pipe laying progresses, and left clean at the completion of the installation.
B. Installation shall commence at the lowest point for each segment of the route. RCP shall be laid with the groove or bell end upstream.
C. Lay pipe to the required line and slope gradients with the necessary fittings, bends, manhole, risers and other appurtenances placed at the required location as noted on Construction Drawings.
D. Do not displace or damage pipe when compacting.
E. No pipe shall be laid in water or when trench conditions are unsuitable for such work.
F. Joints:
   1. Joints shall be constructed as described herein with the intent that they be made watertight.
   2. For RCP, the joint surface shall be cleaned and washed with water, if necessary, before the joints are made. Join reinforced concrete sewer piping according to ACPA’s “Concrete Pipe Installation Manual” for rubber gasketed joints.
   3. PVC fittings shall be attached to the pipe by solvent welding according to the manufacturers recommendations.
3.05 INSTALLATION - CATCH BASINS, INLETS, AND JUNCTION BOXES

A. Precast Sections:
   1. Precast section with bases shall be installed in accordance with Section 02322 or as shown on construction drawings.
   2. Pipe openings shall be aligned to that of the pipe entering and leaving the manhole, etc. Pipe shall be properly aligned with connections to manholes, etc. as shown on the construction drawings.

B. Cast-In-Place sections shall be as shown on the drawings and in accordance with Section 02322.

C. Frames and Covers:
   1. Frames and covers shall be set to the proper elevation. The frames shall be firmly embedded in mortar approximately 1 inch thick and aligned to fit the top section of the structure.
   2. Bricks set in mortar used to adjust the frame to finished grade shall be limited to no more than four courses.
   3. Adjustment rings used to make adjustments in grade shall be made with the initial ring embedded in mortar and the exterior of the rings parged with mortar not less than 1/2 inch thick. No adjustment made in this manner shall exceed 8 inches.

D. Concrete cradles shall be constructed as shown on the construction drawings and as needed when crossing over and under sewer pipe or utility lines. Concrete is to be 3000 psi mix with a minimum thickness of 6 inches.

3.06 SUBDRAINS

A. Subdrains shall be installed in accordance with the details and at the locations shown on the construction drawings.

3.07 INSPECTION AND TESTING

A. General
   1. Strom sewer systems and culverts, upon completion or at such time as directed, shall be cleaned, inspected and tested. The system or culvert shall have a true grade and line. Actual elevations shall be within 0.08 feet of the elevations given on the construction drawings.
   2. After completion of the Work, or any part thereof, the job shall be tested to determine that it has been installed in accordance with the construction drawings and specifications. In general, the Work shall prove to be in good condition, installed in accordance with the construction drawings and specifications and ready for use.

B. Cleaning and Testing
   1. The contractor is to visibly inspect and remove all debris and obstructions from storm pipe. All storm pipe is to be tested for infiltration and exfiltration by hydrostatic testing per ASTM C969. All manholes and pipe shall meet ASTM C969 leakage criteria.

C. Alignment Test
   1. After backfill has been placed and compacted to a depth not less than one foot above top of pipe, a visual inspection shall be made by flashing a light between manholes. Any displacement or misalignment of invert shall be corrected.

END OF SECTION 02630
SECTION 02740 - ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

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

B. Asphalt concrete paving above base course; as indicated on the drawings, specified herein, and complete with all accessories.

C. Aggregate base course.

D. Bituminous tack coat.

E. Asphalt Concrete Paving; Binder Course and Wearing Course Surfaces.
   1. Parking Lot Pavement.
   2. Driveway Pavement.
   3. Walkway Pavement.

F. Paint Striping and Logos.

1.2 RELATED SECTIONS

A. Section 02220 – Selective Site Demolition

B. Section 02230 – Site Clearing

C. Section 02300 – Earthwork

D. Section 02510 – Water Distribution Systems

E. Section 02535 – Sanitary Sewer Systems

F. Section 02630 – Storm Drainage

G. Section 02750 – Exterior Concrete Pavement

H. Section 02930 – Landscape Work

1.3 REFERENCES

A. ALDOT, Alabama Department of Transportation Standard Specifications for Construction. Only applicable portions of construction methods and materials apply. References to methods of measurement or payment are not applicable.

   1. ALDOT 410 – Plant Mixed Hot Mix Asphalt Pavement
   2. ALDOT 405 - Bituminous Tack Coat
   3. ALDOT 402 and ALDOT 802 - Fine Aggregate for Bituminous Slurry Seal Coat
   4. ALDOT 801 - Aggregate for Surface and Base Courses
   5. ALDOT 800 - Graded Aggregate for Bituminous Mixtures
   6. ALDOT 804 - Bituminous Material

B. MS-2 – Mix Design Methods for Asphalt Concrete and Other Hot Mix Types - The Asphalt Institute (A1).
C. All Materials and Products Used Shall Comply With Alabama Department of Transportation Standard Specifications for Highway Construction.

1.4 QUALITY REQUIREMENTS

A. General: In addition to other specified conditions, comply with the following minimum requirements:

1. Subcontractor's Qualifications: The construction of bituminous paving, including the stabilized aggregate base, shall be done by a responsible Paving Subcontractor having the necessary equipment, plant and experience to perform the work.

2. Test in-place asphalt concrete courses for compliance with requirements for density, thickness and surface smoothness.

3. Provide final surfaces of uniform texture, conforming to the required grades and cross-sections.

4. Take not less than six (6") inch diameter pavement specimens for each completed course, from locations as directed by the Architect/Engineer. There will be a total of four (4) test specimens for each course. These specimens shall be obtained by core drilling.

5. Repair holes from test specimens as specified for patching defective work.

6. Governing Codes: The Work of this section occurring on public property shall be constructed in accordance with the laws, ordinances, rules, regulations and orders of any public authority having jurisdiction. All work required to be constructed by regulatory authorities in a manner differing from the Contract Documents shall be considered part of the Base Bid Contract.

B. Density: Minimum acceptable density of in-place material is 95 percent of the recorded laboratory specimen density - Marshall Design.

1. Asphalt paving densities below 95% will require bituminous pavement removal and replacement, at the Owner's discretion.

C. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from thickness specified herein.

1. Base Course: Plus or minus one-fourth (±1/4") inch.

2. Surface Course: Plus or minus one-fourth (±1/4") inch.

3. Aggregate Base Course: Plus or minus one-half (±1/2") inch.

D. Surface Smoothness:

1. Test finished surface of each asphalt concrete course for smoothness, using a ten (10') foot straightedge applied parallel to and at right angles in centerline of paved areas.

2. Check surfaced areas at intervals as directed by the Geotechnical Engineer.

3. Surfaces will not be acceptable if exceeding the following:

   a. Base Course: One-fourth (1/4") inch in ten (10') feet.

   b. Surface Course: Three-sixteenths (3/16") inch in ten (10') feet.

E. Grade Verification:

1. Refer to Part 1.06 and 3.11 of this Section.

1.5 SUBMITTALS

A. Submit under the provisions of Division One Specifications.

B. Samples: Submit ten (10) pound (4.5 kg) sample of aggregate base course material to the Independent Testing Laboratory.
C. Samples: Submit samples of asphalt concrete paving materials and asphalt mix design to the Independent Testing Laboratory.

D. Certificates: The Contractor and the Asphalt Concrete Producer shall jointly provide certificates certifying that materials comply with Specification requirements.

E. Job Mix Design: The bituminous mix plant shall have, on file, a report by an approved testing laboratory that indicates the proportions of materials used in each type of bituminous course being provided and the temperature of the mix.

F. The Contractor is to employ the services of a Registered Land Surveyor to perform the specified layout work and to prepare a grade verification survey. The grade verification shall be submitted prior to project close out.

1.6 SITE CONDITIONS

A. Weather Limitations:
   1. Apply bituminous tack coat only when the ambient temperature is at least 50 degrees Fahrenheit (10 degrees C), and when the temperature has not been below 35 degrees Fahrenheit (2 degrees C) for twelve (12) hours immediately prior to application.
   2. Do not apply materials when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.
   3. Construct asphalt concrete surface course only when atmospheric temperature is above 40 degrees Fahrenheit (4 degrees C), when the underlying base is dry and when weather is not rainy.
   4. Refer to “Minimum Placement Temperature Chart” prepared by the National Asphalt Pavement Association for minimum bituminous placement temperatures.
   5. Paving shall not take place when, in the opinion of the Independent Testing Laboratory, the weather or surface conditions are considered unfavorable.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

C. Traffic Control:
   1. Maintain vehicular and pedestrian traffic during paving operations as required for other construction activities.
   2. Provide flagmen, barricades, warning signs and warning lights for the movement of traffic and safety and to cause the least interruption of the Work.
   3. When working in public right-of-way, the Contractor is responsible for all traffic control and permit requirements. No additional compensation will be allowed to provide these services.

1.7 MATERIAL REQUIREMENTS

A. Mix Criteria:
   1. Provide mix formulas for each required asphalt-aggregate mixture.
   2. Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.
   3. Comply with the mix requirements of the ALDOT standards.
   4. Maintain material quantities within allowable tolerances of the governing standards.

B. Prepare and keep on file the mix formula for each course.
C. The subgrade shall be tested and approved by the Independent Testing Laboratory immediately prior to placement of the base course.

D. The Contractor will be responsible for all drainage of the finish surface. Any “bird baths” will be considered unacceptable and shall be remedied by the Contractor at his/her expense to the satisfaction of the Architect/Engineer.

1.8 SYSTEM DESCRIPTIONS

A. Design Requirements:

1. Heavy Duty Pavements: Design consists of minimum six (6”) inch thick aggregate base course, a minimum two (2”) inch thick asphalt non-wear course, and a minimum one and one-half (1-1/2”) inch thick asphalt wear course.

2. Light Duty Pavements: Design consists of minimum six (6”) inch thick aggregate base course, a minimum one and one-half (1-1/2”) inch thick asphalt non-wear course, and a minimum one and one-half (1-1/2”) inch thick asphalt wear course.

3. Bituminous Walkway Pavements: Design consists of a minimum six (6”) inch thick aggregate base course, and a minimum two (2”) inch thick asphalt wear course.

1.9 WARRANTY

A. Provide one (1) year written warranty under the provisions of Division One Specifications.

B. Warranty: All materials and workmanship provided are guaranteed against defects after completion and final acceptance of the Work. Defects due to faulty materials or workmanship developed during the guarantee period shall be satisfactorily repaired or replaced by the Contractor at his/her expense.

PART 2 PRODUCTS

2.1 AGGREGATE BASE MATERIALS

A. Stabilized Aggregate Base: Aggregate shall meet the requirements of ALDOT 825

B. Aggregate Base Material is to be placed under the bituminous parking lots, drives, bituminous walk and concrete curb and gutter.

2.2 ASPHALT CONCRETE MATERIALS

A. Comply with Division 400 and 800 of ALDOT Specifications

2.3 GRADED AGGREGATES FOR BITUMINOUS MIXTURES

A. Comply with Division 400 and 800 of ALDOT Specifications

2.4 SOURCE QUALITY CONTROL

A. Provide mix design for asphalt under the provisions of Division One Specifications.

B. Submit proposed aggregate base and mix design of each class of mix for review and approval prior to commencement of the Work.

C. Test samples in accordance with A1 MS-2.
2.5 ACCEPTABLE MANUFACTURERS - ASPHALT MARKING PAINT

A. Subject to compliance with requirements, provide products from one of the following manufacturers:

2. Tnemec - “Traffic Paint.”
4. PPG - “Traffic & Zone Marking Paint.”

B. Substitutions: Under the provisions of Division One Specifications.

2.6 PAVEMENT MARKING PAINT

A. Provide paint striping and handicap logos as indicated on the Drawings.

B. Provide paint specifically formulated for use as exterior pavement marking paint in traffic areas, and in the colors selected by the Architect/Engineer from the manufacturer’s standard color range.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that gradients and elevations of subgrade are correct.

C. Aggregate base is to be placed under the concrete curb and gutter by the Asphaltic Concrete Paving Contractor. Coordinate all work with the Exterior Concrete Pavement Contractor.

3.2 SURFACE PREPARATION

A. Proof roll all prepared subgrades using a heavy, rubber-tired roller. (Amount of allowable yielding shall be one (1”) inch maximum) The proof rolling must be observed by the Testing Laboratory Inspector.

1. Check for unstable areas and areas requiring additional compaction.

B. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

C. Remove loose and foreign material from compacted subbase surfaces immediately before paving application. Do not disturb subbase material.

3.3 TACK COAT

A. Apply to contact surfaces of previously constructed portland cement concrete surfaces and similar surfaces.

B. Apply at rate of five-hundredths (0.05) to fifteen-hundredths (0.15) gallons per square yard of surface.

C. Apply tack coat by brush to contact surfaces of concrete curbs, gutters, manholes and other structures projecting into or abutting asphalt concrete pavement.
D. Allow surfaces to dry until material is at condition of tackiness and ready to receive pavement.

3.4 AGGREGATE BASE PLACEMENT

A. Subgrade: The area to be paved shall be graded to the elevation of the underside of the stabilized base. Precompact soils beneath the stabilized base to 100 percent of Standard Proctor Density (ASTM D698). Recompact as necessary to provide the specified density for the subgrade.

B. Remove all castings set by others that are within the paving area and replace with metal covers. The castings shall be reset as outlined below.

C. Spread aggregate base over prepared base to a total compacted thickness as indicated on the System Descriptions 1.08.

D. Place aggregate base in maximum three (3") inch layers and roller compact.

E. Level and contour surfaces to elevations and gradients indicated on the Drawings.

F. Compact placed aggregate materials to achieve compaction to 100 percent of its maximum dry density in accordance with ASTM D698.

G. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

H. Use mechanical vibrating tamping in areas inaccessible to compaction equipment.

3.5 PLACING THE MIX – DOUBLE COURSE

A. Place asphalt concrete mixture on prepared surfaces, spread and strike-off using paving machine.

B. Inaccessible and small areas may be placed by hand.

C. Place each course at thickness so that when compacted it will conform to the indicated grade, cross-section, finish thickness and density indicated.

D. Pavement Placing:
   1. Unless otherwise directed, begin placing binder course at high side of section on one-way slope.
   2. After first strip has been placed and rolled, place succeeding strips.
   3. Complete binder courses for a section before placing wearing courses.
   4. Place mixture in continuous operation as practicable.
   5. Place tack coat before placing wear course.
   6. Base course shall be swept as required before placing wear course.

E. Hand Placed:
   1. Spread, tamp and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to the Geotechnical Engineer.
   2. Place mixture at a rate that will ensure handling and compaction before mixture becomes cooler than acceptable working temperature.

F. Joints:
   1. Gradually make joints between old and new pavements, or between successive day’s work, to ensure a continuous bond between adjoining work.
   2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
3. Clean contact surfaces free of sand, dirt or other objectionable material and apply tack coat.
4. Offset transverse joints in succeeding courses not less than five (5') feet.
5. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.
6. Offset longitudinal joints in succeeding courses no less than six (6") inches.
7. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory section to expose as even, vertical surface for the full course thickness.

3.6 COMPACTING THE MIX

A. Provide sufficient number of rollers to obtain the required pavement density of 95 percent of the recorded laboratory specimen density.

B. Begin rolling operations as soon after placing mix when the mixture will bear weight of roller without excessive displacement.

C. Do not permit heavy equipment, including rollers, to stand on finished surface before it has thoroughly cooled or set.

D. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.

F. Do not roll centers of section first under any circumstances.

G. Breakdown Rolling:
   1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
   2. Operate rollers as close as possible to the paving machine without causing pavement displacement.
   3. Check crown, grade and smoothness after breakdown rolling.
   4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:
   1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
   2. Continue second rolling until mixture has been thoroughly compacted.

I. Patching:
   1. Remove and replace defective areas.
   2. Cut-out and fill with fresh, hot asphalt concrete.
   3. Compact by rolling to specified surface density and smoothness.
   4. Remove deficient areas for full depth of course.
   5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.
   6. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

3.7 MANHOLE AND GATE VALVE PROTECTION

A. Cover manholes, catch basins and gate valves lying within the surface to be sealed to as to prohibit the bituminous material from being placed thereon.
B. Clean the surface of these structures following the application of the cover aggregate.

3.8 TOLERANCES

A. Flatness: Maximum variation of one-fourth (1/4") inch measured with a ten (10') foot straight edge.

B. Scheduled Compacted Thickness: Within one-fourth (1/4") inch.

C. Variation from True Elevation: Within one-fourth (1/4") inch.

3.9 ADJUSTING CASTINGS

A. Castings shall be raised after the bituminous base course is placed and prior to installing the wear course.

B. The bituminous base shall be sawcut around the cover plate. The bituminous aggregate and cover plate shall be removed.

C. The casting shall be set to final grade using adjusting rings and mortar. No blocks will be allowed.

D. The aggregate base shall be placed to the design depth around the casting. The bituminous patch mix shall be placed and tamped around the casting to bring the grade up to the surface of the bituminous base.

E. The final grade of castings in paved areas shall be one-fourth (1/4") inch to one-half (1/2") inch below the top of the completed wear course. The castings shall be set to the contour of the finished surface so that the required tolerance is uniform around the circumference of the casting. The one-fourth (1/4") inch to one-half (1/2") inch tolerance shall be measured at the immediate edge of the casting and no “straightedge” measurements shall be accepted. A plywood template, one-half (1/2") inch thick, shall be fastened to the top of all non-adjustable castings during placing and rolling of the wear course to ensure that the required tolerances are met.

F. All final adjustments to the adjustable castings shall be made by means of the casting adjustment bolts.

G. All castings, which do not meet the required tolerances, shall be removed and re-adjusted at the Contractor's expense.

3.10 FIELD QUALITY CONTROL

A. Field testing and inspection shall be performed by qualified parties as specified herein and in accordance with the provisions of Division One Specifications.

B. Aggregate base compaction testing will be performed in accordance with ASTM D698.

C. Frequency of Tests: Provide minimum of four (4) compaction tests at locations as directed by the Architect/Engineer.

D. Flood Test:
   1. After completion, flood the entire asphalt concrete paved areas (including tennis courts) with water by use of a tank truck or hoses.
   2. If a depression is found where water ponds to a depth of more than one-eighth (1/8") inch in six (6') feet, fill areas or otherwise correct to provide proper drainage.
   3. Feather and smooth the edges of fill so that the joint between the fill and the original surface is invisible.
E. Grade Verification of Aggregate Base: A grade verification survey shall be performed after the aggregate base has been installed. This should be on the same grid system as specified in Section 02300 – Earthwork Part 3.13. The surveyor shall issue a letter certifying that the grades are within the specified tolerances.

F. Grade Verification of Bituminous Pavement: A grade verification survey shall be performed after the final lift of bituminous pavement has been completed. This will be on the same grid system as the grade verification of aggregate base. The surveyor shall issue a letter certifying that the grades are within the specified tolerances.

G. If tests indicate that the Work does not meet the specified requirements, remove the Work, replace and retest at no additional cost to the Owner.

H. Take asphalt mixture samples and perform tests in accordance with A1 MS-2.

3.11 CLEANING

A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the Architect/Engineer.

B. When marking paint is thoroughly dry, visually inspect the entire applications, and:
   1. Touch up paint as required to provide clean, straight lines and surfaces throughout.
   2. Using a permanently opaque paint identical in color to the surface on which the paint was applied, block out and eliminate all traces of splashed, tracked and/or spilled pavement marking paint from the background surfaces.

3.12 PROTECTION

A. The Contractor shall be required to protect all adjacent concrete surfaces from chipping and damage during the asphalt pavement placement.

B. Protect all concrete surfaces from staining or discoloration during placement of asphalt materials or vehicle trucking during construction.

C. Immediately after placement of asphalt paving, provide traffic cones, barricades and other devices needed to protect pavement and marking paint from mechanical injury for a minimum of seven (7) days.

END OF SECTION
SECTION 02750 - EXTERIOR CONCRETE PAVEMENT

1. **GENERAL**

1.01 **Section Includes**
   A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
   
   B. Exterior Concrete Pavement Systems Above Base Course; as Indicated on The Drawings, Specified Herein, and Complete With All Accessories.
   
   C. Granular Base Under Exterior Concrete Sidewalk Work is Specified Under the Provisions of Section 02300.
   
   D. Exterior Concrete Work:
      1. Concrete Curb and Gutter
      2. Sidewalks
      3. Concrete Pavement
      4. Stair Steps
      5. Ramps
   
   E. Provide and install sealant and joint backing.

1.02 **Related Sections**

   A. Section 02300 – Earthwork

1.03 **References**

   A. ALDOT, Alabama Department of Transportation Standard Specifications for Construction. Only applicable portions of construction methods and materials apply. References to methods of measurement or payment are not applicable.
   
   B. American Concrete Institute (ACI) 117-90, “Standard Specification for Tolerances for Concrete Construction and Materials”
   
   C. American Concrete Institute (ACI) 301-99, "Specifications for Structural Concrete for Buildings"
   
   D. American Concrete Institute (ACI) 304R-89, "Guide for Measuring, Mixing, Transporting, and Placing Concrete"
   
   E. American Concrete Institute (ACI) 305R-91, "Hot Weather Concreting"
   
   F. American Concrete Institute (ACI) 306R-88, "Cold Weather Concreting"
   
   G. American Concrete Institute (ACI) 306.1-90, "Standard Specification for Cold Weather Concreting"
   
   H. American Concrete Institute (ACI) 308-92, "Standard Practice for Curing Concrete"
   
   I. American Concrete Institute (ACI) 309R-96, "Guide for Consolidation of Concrete"
   
   J. American Concrete Institute (ACI) 318-95, "Building Code Requirements for Reinforced Concrete"
   
   K. ASTM C31/C31M-98, “Making and Curing Concrete Test Specimens in the Field”.”
The complete exterior concrete Work shall give the appearance of uniformity in surface contour and texture and shall be accurately constructed to line and grade. The required joints shall show neat workmanship.

Work under this section shall comply with the requirements of ALDOT specifications.

Submit under the provisions of Division One Specifications.

The independent testing laboratory will submit concrete compression tests, entrained air test, and slump test reports.

Delivery Tickets: Submit one copy to Architect indicting quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump and time of batching for each load delivered.

Product Data: Provide manufacturer’s data on joint filler and curing compounds.

Contractor shall submit mix designs and aggregate test reports, directly from testing laboratory. Submit mix designs and aggregate test reports at least 14 days prior to placing. Do not place concrete until the Architect/Engineer has reviewed mix designs and aggregate test reports. Mix identification designation.

Environmental Requirements
A. Cold Weather Protection: Place and protect concrete in accordance with ACI 306, and the following:
   1. When mean daily temperature is 40°F or lower, provide suitable protection for concrete work as required to maintain minimum concrete temperature of 50°F for five (5) days, or 70°F for three (3) days.
      a. So as to avoid thermal shock to the finished work, following protection period, do not allow concrete to cool more than 20°F each successive day.

B. Hot Weather Protection: Place and protect concrete in accordance with ACI 305. Employ suitable means to prevent too-rapid drying. Shade fresh concrete as soon as is possible without marring surface.

C. Wet Weather Protection: Do not place concrete in rain, sleet, or snow, without providing adequate protection.

1.07 Quality Assurance

A. Perform the Work in accordance with ACI 301 and ACI 318.

B. Acquire cement and aggregate from same source for all Work.

C. Work under this Section shall comply with the requirements of ALDOT Specifications. The Owner shall employ the services of an independent testing lab to perform the specified field quality control.

D. Quality Control:
   1. Do not commence placement of concrete until mix design has been reviewed and approved by the Architect/Engineer and until copies are at the jobsite, the batch plant and the building inspection department.

1.08 Delivery Storage and Handling

A. Furnish delivery tickets with each load of concrete delivered to the Project. Information on each ticket shall be as follows:
   1. Name of ready-mix batch plant.
   2. Ticket number.
   3. Date.
   4. Truck number.
   5. Project name and location.
   6. Type of concrete (mix number).
   8. Weights of all ingredients.
   9. Time loaded or time of first mixing.
   10. Maximum aggregate size.
   11. Type, brand, and amount of admixtures.
   12. Total water in the batch and maximum amount of water that can be added at the site without exceeding design mix proportions.
   13. Amount of water added at site and initials of person adding water.

B. The Contractor shall retain delivery tickets for the duration of construction.

1.09 Field Measurements

A. Verify actual locations of exterior concrete work and other construction to which concrete work must fit, by accurate field measurements before installation. Show recorded measurements on final Shop Drawings. Coordinate installation schedule with construction progress to avoid delay of the Work.

B. The Contractor is to employ the services of a registered land surveyor to perform the specified layout work.
1.10 **Warranty**

A. Provide one (1) year written warranty under the provisions of Division One Specifications.

B. Warranty: All materials and workmanship provided are guaranteed against defects after completion and final acceptance of the Work. Defects due to faulty materials or workmanship developed during the guarantee period shall be satisfactorily required or replaced by the Contractor at his/her expense.

2. **PRODUCTS**

2.01 **Materials**

1. **Cement**
   - Cement for normal weight structural concrete: ASTM C150, Type I.
   - Cement for high early strength structural concrete ASTM C150, Type III.
   - Use only one type and brand of Portland Cement for all exposed concrete. Architect's permission is required to change brands.

2. **Aggregates**
   - Maximum nominal size of coarse aggregate shall be ¾” for all concrete.
   - Limits for deleterious substances and physical properties of coarse aggregate for concrete shall meet the requirements of ASTM C33, 3/4", Class 4S.

3. **Water**: Clean and free from deleterious amounts of acids, alkalis or organic materials.

4. **Reinforcement**
   - Synthetic fibrous reinforcement: 100% virgin polypropylene. The fiber shall comply with ASTM C1116, 4.1.3. and shall be a minimum of 1 1/2 inches long. Fibers shall be added to the concrete sidewalk mix at the rate of 1.5 pounds per cubic yard.

2.02 **Accessories**

1. **Curing Materials**
   - Moisture-Retaining Cover: ASTM C171, waterproof paper or polyethylene film.
   - Liquid Membrane Curing Compound: ASTM C309, Type 2, Class B.

2. **Form Release Agent**: Commercial product to facilitate stripping without staining or damaging concrete or impairing future concrete treatment.

3. **Expansion Joint and Isolation Joint Filler**: ASTM D1751, performed, resilient, non-extruding, asphalt impregnated joint filler, 1/2" thick unless otherwise indicated.

4. **Provide granular cushion material under all other exterior concrete work as specified under the provisions of Section 02300.**

5. **Evaporation Retardants**
   - An evaporation-retarding agent may be used during the concrete finishing operation to control plastic cracking of the fresh concrete.
   - Acceptable materials are:
     - “Confilm”, by Master Builders
     - “Eucobar”, by Euclid Chemical Co.

2.03 **Products**

1. **Concrete Walks**: ALDOT Specification, as detailed and dimensioned on the Drawings.
B. Concrete Curbs/Gutters: N/A

2.04 Mixes

A. Provide mixes meeting the following minimum requirements. Submit concrete mix design for each type of concrete. Mix designs must be reviewed prior to pouring concrete. Review is for conformance with specification requirements only. Contractor is responsible for performance.
1. 28-day Compressive Strength: 4,000 psi.
3. Maximum Slump: 4".
4. Air Content ASTM C231: 6-1/2% ±1-1/2%.
5. Maximum Water/Cement Ratio: 0.40.

B. Concrete shall conform to the requirements of ASTM C94.

C. Provide concrete with workability such that it will fill the forms, without voids or honeycombs, when properly vibrated, without permitting materials to separate or excess water to collect on the surface.

2.05 Form Materials

A. The forms shall be of metal, wood or other suitable material, and shall be capable of sustaining the concrete in its proper position until set. Do not use aluminum materials in contact with concrete. Concrete form materials must be used in a manner to provide the surface finish specified.

B. Form Coating Material: ALDOT Specification, forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.

C. Side forms shall have a height at least equal to the edge thickness of concrete being formed.

D. Flexible or curved forms shall be used on curves having a radius of 150 feet or less.

E. Face forms for curbing shall conform to the shape and design of the curb.

2.06 Source Quality Control

A. Provide concrete mix design under the provisions of Division One Specifications

B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of work.

C. Provide an independent testing laboratory to perform the following:
1. At the beginning of the concrete operations for the project and for each 1,000 yards of concrete delivered to the project, test the fine and coarse aggregate gradation in accordance with ASTM C136 for conformance with this specification.
2. Verify that the concrete supplied meets the mix design requirements.
3. Submit test results to the Architect/Engineer.

3. EXECUTION

3.01 Examination

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

B. Verify that compacted granular base is acceptable and ready to support paving and imposed loads.
C. Verify that gradients and elevations of base are correct.

3.02 Base Placement

A. Spread granular cushion (02300) over prepared base to a total compacted thickness as indicated on the Drawings.

B. Place granular cushion base in maximum three (3") inch layers and roller compact.

C. Level and contour surfaces to elevations and gradients indicated on the Drawings.

D. Compact placed aggregate materials to achieve compaction to 100 percent of its maximum dry density in accordance with ASTM D698.

E. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

F. Use mechanical vibrating tamping in areas inaccessible to compaction equipment.

3.03 Preparation

A. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement.

B. The Contractor shall notify the Architect/Engineer and the Independent Inspection Agency a minimum of twenty-four (24) hours prior to commencement of concreting operations.

C. Base Preparation: The base shall be well drained and compacted with an approved vibrator compactor to a firm, uniform bearing surface, conforming to the planned section and established grade. Granular materials shall be thoroughly wet down so as to be in a moist condition immediately prior to placement of concrete.

3.04 Forming

A. Place and secure forms to correct location, dimension and profiles.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

D. Install forms to allow continuous progress of Work and so that forms can remain in place at least twenty-four (24) hours after concrete placement.

E. Slipform equipment may be used if the resulting curb and gutter conforms to the shape as specified on the drawings and the finish is satisfactory to the Architect/Engineer.

3.05 Reinforcement

A. Synthetic fibrous reinforcement shall be added to the concrete sidewalk mix at a rate of 1.5 pounds per cubic yard.

3.06 Jointing

A. Expansion Joints: Joints shall be filled with one-half (1/2") inch thick pre-formed joint filler material and shall be installed in the following locations:
   1. At the beginning and end of all curved sections.
   2. Where all new concrete surrounds, adjoins or abuts any existing fixed objects, such as fire hydrants, valve boxes, manholes, light poles, flag poles, curbs, walks or other rigid structures.
   3. At sixty (60') foot maximum spacing or as indicated on the drawings.
B. **Contraction Joints:** Curbing shall be provided with contraction joints at ten (10') feet on center or as indicated on the Drawings.

C. **General:** All joints shall be vertical and straight. Transverse joints shall be placed at right angles to the longitudinal axis of the Work. Joints shall align with similar joints in adjoining work where practical.

D. The panels shall be square where practicable and generally have not more than 36 square feet of area.

E. The joints shall align with like joints in adjoining work unless the work is isolated by ½ inch isolation joints.

F. All joint work shall coordinate precisely with grids, modules and radials as prescribed on the Drawings.

G. All joints and edges of walk shall be rounded with a 1/8-inch radius tool.

H. Contraction joints shall extend to at least 1/3 the walk thickness and shall be approximately 1/8 inch wide.

I. Expansion and isolation joints shall be ½ inch wide and shall be equal in depth to the full thickness of the slab.

### 3.07 Placing Concrete

A. Place concrete in accordance with ACI 301 and comply with the requirements for mixing and placing concrete as herein specified.

B. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

C. Immediately before concrete placement, dampen base to reduce absorption. Standing water will not be permitted.

D. Do not place concrete on frozen ground.

E. Incorporate all concrete admixtures into the concrete at the ready-mix plant.

F. Reject concrete not placed within 90 minutes of initial mix.

G. Install safety stair nosing to be cast into all exterior poured concrete stair treads.

H. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

I. Place concrete to pattern indicated on the Drawings or as directed by the Architect/Engineer.

J. Place concrete by methods that prevent segregation of the mix. Consolidate concrete along the face of the forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement and side forms.

K. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

### 3.08 Concrete Finishing

A. After striking off and consolidating concrete, smooth surfaces by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
B. After floating and before final finishing, check the concrete with a ten (10') foot steel straightedge to ensure there is no variation greater than three-sixteenth (3/16") inch from the straightedge.

C. Work edges of slabs, gutters top edge of back of curbs and formed joints with an edging tool, and round to one--half (1/2") inch radius, unless otherwise indicated. Eliminate tool marks on concrete surfaces.

D. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surfaces as follows:
   1. Sidewalks: Light broom, radius edges to one (1") inch
   2. Stair Steps: Light broom, and integrally cast stair nosings into each tread.
   3. Inclined Ramps: Light broom perpendicular to slope.

3.09 Concrete Curing

A. Compound Application:
   1. Apply a membrane-curing compound to the exposed surface of the concrete within one (1) hour of finishing the concrete.
   2. The compound shall be thoroughly mixed before it is applied.
   3. If forms are removed in less than seventy-two (72) hours after placing the concrete, the curing compound shall be applied immediately to the exposed surfaces.
   4. The curing compound shall be applied by an approved airless spraying machine at the approximate rate of one (1) gallon of compound to 150 square feet of surface curing area.
   5. In all cases, the Contractor shall be responsible for the protection of the concrete from frost during the cure period.
   6. The Architect/Engineer will shut down concrete placement if the operations are not being carried out according to these specifications.

3.10 Pavement Joint Sealing

A. Prepare joints and sealing compounds in accordance to the manufacturers installation instructions.

B. Install sealing compounds where indicated on Drawings in accordance with manufacturer's instructions and ASTM D3406.

3.11 Field Quality Control

A. Conventional testing and inspection services herein describe those items not specifically required by the Alabama State Building Code, but are considered essential to the proper performance of the building systems.

B. Field testing and inspection shall be performed by qualified parties as specified herein and in accordance with the provisions of Division One Specifications:
   1. Compressive Strength Tests:
      a. Make one set of test cylinders (three per set) ASTM C31, for each day's pour in excess of one cubic yard for each type of concrete. If day's pour exceeds 25 cubic yards, make one set of test cylinders for each additional 50 cubic yards or fraction thereof.
      b. Cure cylinders in same proximity to and protected and cured in same manner as in-place concrete from which taken. Deliver one cylinder to independent testing lab at 7 days and 2 cylinders for testing at 28 days.
   2. Slump Tests:
      a. Furnish and maintain a slump cone and tamping rod. Test first batch of each type of concrete delivered for each day's pour, plus one test for each 25 cubic yards or fraction thereof, ASTM C143.
   3. Entrained Air Tests:
a. Furnish and maintain a properly calibrated pressure-type air meter. Test first batch of air entrained concrete delivered for each day’s pour plus one test for each 50 cubic yards or fraction thereof, ASTM C231.

4. Sidewalks, paths and walkways shall meet ADA accessibility standards. Replacement of walks is required if over 5 percent longitudinal grade, over 2 percent cross slope, over 2 percent at 90 degree changes in direction (landings) and 1 percent within 5 feet of a building entrance.

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

D. Grade verification of exterior Walks: A grade verification survey shall be performed after all walks are installed to assure Part 3.12.B.4. has been satisfied.

3.12 Protection

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures and mechanical injury.

END OF SECTION
SECTION 02760 - STAMPED CONCRETE PAVEMENT

1. GENERAL

1.1 SUMMARY
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.

B. Section Includes:
1. Dry-shake colored hardener applied to sidewalks and patios.
2. Stamping/Imprinting.
3. Curing of colored and imprinted concrete.

C. Related Sections:
1. 02750 Concrete

1.2 REFERENCES
A. American Concrete Institute (ACI):
1. ACI 301 “Specification for Structural Concrete for Buildings.”
2. ACI 302 IR “Recommended Practice for Concrete Floor and Slab Construction.”
3. ACI 303.1 “Standard Specification for Cast-In-Place Architectural Concrete.”
4. ACI 304 “Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete.”
5. ACI 305R “Recommended Practice for Hot Weather Concreting.”
6. ACI 306R “Recommended Practice for Cold Weather Concreting.”

B. American Society of Testing and Materials (ASTM):
1. ASTM C309 “Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.”
2. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”

1.3 SUBMITTALS
A. Product Data: Submit manufacturer's complete technical data sheets for the following:
1. Dry-shake colored hardener.
3. Imprinting/Texturing tools.

B. Design Mixes

C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

D. Qualification Data: For firms indicated in "Quality Assurance" Article, including list of completed projects.
1.4 QUALITY ASSURANCE
A. Manufacturer Qualifications: Manufacturer with 10-years experience in manufacture of specified products.
B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality. Installer shall certify that 75% of his work involves Patterned Stamped Concrete.
C. Comply with the requirements of ACI 301.
D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.
E. Colored Concrete Mockups/Field Samples:
   1. Per Division 1 Section “Quality Control.”
   2. At location on Project selected by Architect or Owner’s Representative, place and finish 10 feet by 10 feet in area.
   3. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
   4. Accepted mockup provides visual standard for work of Section.
   5. Mockup shall remain through completion of the work for use as a quality standard for finished work.
   6. Remove mockup when directed.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver products in original factory unopened, undamaged packaging bearing identification of product, manufacturer, batch number, and expiration data as applicable.
B. Store the product in a location protected from damage, construction activity, and precipitation in strict accordance with the manufacturer’s recommendations.

1.6 PROJECT CONDITIONS
A. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
B. Avoid placing concrete if rain, snow, or frost is forecast within 24-hours. Protect fresh concrete from moisture and freezing.
C. Comply with professional practices described in ACI 305R and ACI 306R.

1.7 PRE-JOB CONFERENCE
A. One week prior to placement of concrete, or as directed by the Owner’s Representative, a meeting shall be held to discuss the Project and application methods.

2. PRODUCTS
2.1 ACCEPTABLE MANUFACTURER
A. L.M. SCOFIELD COMPANY, Douglasville, Georgia (800) 800-9900 or the appropriate local contact: Eastern Division – 201-672-9050, or approved equal.

2.2 MATERIALS
A. Dry-shake Colored Hardener: LITHOCHROME® Color Hardener; L.M. SCOFIELD COMPANY, factory proportioned, mixed, and packaged, ready-to-use surface hardener. Dry Shake
Hardener shall be gap graded and shall be verified by the manufacturer to pass a compressive test in a 2" x 2" cube test to perform in excess of 8,000 psi.

B. Dosage Rate for Dry shake hardener – 90 pounds per 100 square feet.

C. LITHOTEX® Pavecrafters® imprinting tools; L.M. SCOFIELD COMPANY.

D. Powder Antiquing Release Agent: LITHOCHROME® Antiquing Release; L.M. SCOFIELD COMPANY.
   1. Powder antiquing release agent shall be recommended by pattern tool manufacturer and compatible with dry-shake colored hardener.

E. Sealing Compound: Cureseal-W™ Semi Gloss, and Cureseal-VOC™ Matte; L.M. SCOFIELD COMPANY. Curing and sealing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.

F. SUBSTITUTIONS: The use of products other than those specified will be considered providing that Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:
   1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section.
   2. Documented proof that proposed materials have a 10-year proven record of performance confirmed by at least 5 local projects that Owner, Owner's Representative, or Architect can examine.

2.3 COLORS

A. Visitor Paths “Fractured Earth” Pattern
   2. Imprinting Pattern: L.M. Scofield LITHOTEX Pavecrafters imprinting tools: Fractured Earth, 900

B. Café Plaza and Seating Areas “Sandstone Random Interlocking” Pattern
   2. Imprinting Pattern: L.M. Scofield LITHOTEX Pavecrafters imprinting tools: Sandstone Random Interlocking, 435

2.4 CONCRETE MIX DESIGN

A. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches.

B. Do not add calcium chloride to mix as it causes mottling and surface discoloration.

C. Supplemental admixtures shall not be used unless approved by manufacturer.

D. Do not add water to the mix in the field.
E. Maximum air content shall not exceed 5 percent.

3. EXECUTION

3.1 CONCRETE PLACEMENT

A. Move concrete into place with square-tipped shovels or concrete rakes.
B. Vibrators, when used, shall be inserted and withdrawn vertically.
C. Concrete shall be struck to specified level with wood or magnesium straight edge or mechanical vibrating screed.
D. The concrete surface shall be further leveled and consolidated with highway magnesium straight edge and/or magnesium bull float.
E. Mechanically float concrete surfaces as soon as concrete surface has taken its initial set and will support weight of a power float machine equipped with float shoes or combination blades and operator.

3.2 INSTALLATION

A. Apply 2/3 of specified application rate to freshly floated concrete surface. Bleed water shall not be present during or following application of first and second shake.
B. Do not throw dry-shake; distribute evenly by hand or mechanical spreader designed to apply floor hardeners. Consult L.M. Scofield for recommended manufacturers of mechanical spreaders.
C. As soon as dry-shake material has absorbed moisture, indicated by uniform darkening of surface, mechanically float concrete surface a second time, just enough to bring moisture from base slab through dry-shake color hardener.
D. Immediately following second floating, apply remaining 1/3 of specified application rate. If applied by hand, broadcast in opposite direction of first application for a more uniform coverage. If a mechanical spreader is used, apply the same manner as previously described.
E. As soon as dry-shake material has absorbed moisture, mechanically float concrete surface a third time.
F. Do not add water to the surface.
G. Begin imprinting operations immediately after applying dry-shake colored hardener, according to manufacturer's written instructions, including application of powder antiquing release agent.

3.3 CURING

A. Imprinted concrete may be cured with kraft paper cure as recommended by manufacturer.
B. As soon as possible after antiquing release has been removed and after moisture content of concrete is low enough that alkali and other salts do not become trapped beneath sealer, normally a minimum of 14 to 28 days after placement, apply 2-coats of specified sealer according to manufacturer's written instructions.
C. There should be no free water on the surface at time of application.

3.4 PROTECTION OF FINISHED WORK

A. Protect finish work under provisions of Division 1.
B. Prohibit foot or vehicular traffic on the newly imprinted concrete surface.
C. Barricade area to protect newly imprinted concrete.
D. Protect floor surface from damage until final inspection and acceptance by Owner.
3.5 APPLICATORS

A. For a list of qualified contractors, contact your local Scofield representative or the appropriate Division Office: Eastern Division - 201-672-9050.

END OF SECTION
SECTION 02831 - FENCES AND GATES

1. GENERAL

1.01 Description of Work

A. Work includes all labor, materials and equipment required for site preparation and installation of the following:
   1. Temporary Construction Fence and Gates.
   2. PVC Coated Exhibit Fence and Gates.
   3. Exclusion Fence and Gates.
   4. Site Railings.
   5. Demonstration Fence.
   6. Accessories.

1.02 Items Furnished but specified under other sections

A. Section 05500 - Misc. Metals: Fabricated anchoring plates, and other miscellaneous metal items required for fence installation.

1.03 Related Sections

A. Section 02220 - Selective Site Demolition
B. Section 03300 - Cast-in-Place Concrete: Concrete used for the installation of fence post footings and concrete dig barriers
C. Section 05500 - Metal Fabrications: Metal Service Doors
D. Section 06100 - Rough Carpentry

1.04 Quality Assurance

A. The installer shall be experienced in fence installations.

E. Thoroughly inspect site and related work. Notify Architect before bidding of any conditions adversely affecting the performance of fencing.

F. Contractor to provide warranty stating that the fencing is secure and stable, tight, corrosion-free, in proper alignment, complete in detail and finish, and free of hazardous conditions at final acceptance and for a period of one year following final close out. This responsibility is in addition to manufacturer's standard warrantee of materials and workmanship.

D. The fences shall be the product of a manufacturer who has demonstrated by actual installations of a similar nature that its product is of the type required. The contractor shall include all supplementary parts necessary or required for a complete and satisfactory installation within the true meaning and intent of the drawings. All runs of the fence shall present the same general appearance and the product of one manufacturer only will be accepted, except for items which do not influence the appearance of the completed fence. No used, rerolled, or open-seam steel shall be permitted in posts, rails or braces.

1.05 References

Trails of Africa  FENCES AND GATES
Birmingham Zoo  02831-1
June 24, 2009
A. ASTM A120 - Pipe, Steel, Black and Hot Dip Galvanized welded and Seamless.


C. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.

1.06 **Submittals**

A. Submit Shop Drawings, Product Data, and Test Reports to the requirements of Section 01330.

1. Submit an overall original site plan indicating location and lengths of all fence and railing types.

2. Submit larger scale individual area site plans indicating detailed layout of all fence and railing types. Indicate locations of the following:
   a. Gates
   b. End Posts
   c. Line Posts
   d. Special Anchoring

3. Indicate all required details indicating the construction of all fence types. Include the following:
   a. Materials List
   b. Connection Details
   c. Anchoring Devices and Details

4. Chain Link Fence: Submit shop drawings for approval, prior to manufacturing, describing and detailing typical and all non-typical line post, terminal post, gate, fabric, materials hardware assemblies, special conditions and all proposed fence/gate alignment sections.

5. Site Hand Rails: Submit shop drawings.

6. Viewrails: Submit shop drawings for approval, prior to constructing, describing and detailing typical framing, supports, hardware and assemblies, special conditions.

B. Product Data: Submit manufacturer's technical data, certified labels indicating conformance with specifications, manufacturing date and lot number for all materials used on the site.

C. Test Reports: Submit concrete test reports for Architect's review and approval.

1.07 **Product Handling**

A. All materials are to be new and delivered to the site in undamaged conditions. Store materials off the ground and protect from damage. In the event of damage, immediately make repairs and/or replace as necessary to the approval of the Architect and at no additional cost to the Owner.

2. **PRODUCTS**

2.01 **Chain Link Fence and Gate Material for Temporary Construction Fence**

A. Fabric: Provide the following chainlink fabric where indicated on the Drawings.

1. 11 gauge, 2" x 2" wire mesh galvanized in accordance with ASTM A392 Class 2 (2.0 oz per square foot of surface area); twisted and barbed selvages at top twisted and knuckled bottom selvage.

B. Intermediate Posts: 2-1/2" O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.

C. End Posts, Corner Posts, and Gate Posts: 3" O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.
D. Brace Rail: 1-5/8" O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120.

E. Tension Wire: 7 gauge, galvanized.

F. Caps: Cast steel galvanized; sized to post diameter; set screw retainer.

G. Fittings: Sleeves, bands, clips, rail ends, tension bars, turnbuckles, fasteners and fittings; ASTM A123 galvanized steel.

H. Gate Hardware: Fulcrum latch with gravity drop; two 180-degree gate hinges per leaf and hardware for padlock. Heavy-duty hinges and associated hardware shall be used.

2.02 Boma Barrier

A. Vertical Wood Posts: 12" diameter pressure treated Southern Pine, No. 2 grade or better.

B. Steel Support Posts: 8" OD schedule 40 steel posts, primed and painted, color to be selected by Architect.

C. Steel Straps: ¼" thick x 4" wide, primed and painted, color to be selected by Architect.

D. Hotwire Support Posts: Duracane synthetic bamboo, by “Safari Thatch” or approved equal, 4" diameter.

E. Fasteners and Hardware: Galvanized steel.

F. Paint: See Section 09900 for staining and sealing, color to be selected by Architect

2.03 Chainlink Barrier (Hoofstock) Fences and Gates

A. The fabric shall be 2"x 2"x No. 9 gauge wire mesh galvanized in accordance with ASTM A392 Class 2 (2.0 oz per square foot of surface area). Fabric shall be woven in a continuous mesh. Fabric shall have both top and bottom knuckled selvages. Height of fabric to be as indicated on the drawings. Extend mesh below grade for dig barrier as indicated on drawings.

B. Line Posts: 2 3/8” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.

C. End Posts, Corner Posts, and Gate Posts: 3” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.

D. Brace Rails: 2” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120.

E. Tension Cable: 3/8” diameter, 7 x 7 strand stainless steel aircraft cable.

F. Dig Barrier: 2”x2”x 9 gauge mesh.

G. Caps: Cast steel galvanized; sized to post diameter; set screw retainer.

H. Wire ties: The fabric shall be securely fastened to the line posts by means of #7 gauge galvanized steel wire, spaced approximately on twelve (12) inch centers.
I. Fittings: Sleeves, bands, clips, rail ends, tension bars, turnbuckles, fasteners and fittings; ASTM A123 galvanized steel.

J. Gate Hardware: Fork latch with gravity drop; two 180 degree gate hinges per leaf and hardware for padlock. Heavy duty hinges and associated hardware shall be used where gate posts exceed 3”.

2.04 Chainlink Security Fences and Gates

A. The fabric shall be 2”x2”x No. 11 gauge wire mesh galvanized in accordance with ASTM A392 Class 2 (2.0 oz per square foot of surface area). Fabric shall be woven in a continuous mesh. Fabric shall have both top and bottom knuckled selvages. Height of fabric to be as indicated on the drawings.

B. Line Posts: 2 3/8” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.

C. End Posts, Corner Posts, and Gate Posts: 3” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120, with not less than 1.8 oz zinc per square foot of surface.

D. Brace Rails: 1 5/8” O.D. schedule 40 steel pipe galvanized in accordance with ASTM A120.

E. Tension Cable: 3/8” diameter, 7 x 7 strand stainless steel aircraft cable.

F. Dig Barrier: n/a

G. Caps: Cast steel galvanized; sized to post diameter; set screw retainer.

H. Fittings: Sleeves, bands, clips, rail ends, tension bars, turnbuckles, fasteners and fittings; ASTM A123 galvanized steel.

I. Gate Hardware: Fork latch with gravity drop; two 180 degree gate hinges per leaf and hardware for padlock. Heavy duty hinges and associated hardware shall be used where gate posts exceed 3”.

2.05 Welded Wire Mesh Exclusion Fence and Gates

A. 2”x2”x14 gauge black vinyl coated welded wire mesh as manufactured by McNichols Co., Tampa, Florida, 1-800-237-3820, or approved equal.

B. T-Posts: Steel studded, galvanized, prime and paint black.

C. End and gate posts to be schedule 40 steel pipe and cap and 1-1/2” O.D. gate frame, with black vinyl coating, conforming to ASTM A120.

D. Bands, clips, tension bars, turnbuckles, fasteners and fittings; ASTM A123 galvanized steel with black vinyl coating.

E. Gate Hardware: Fulcrum latch with gravity drop, two 180-degree gate hinges per leaf and hardware for padlock.

F. Tension Wire: 9 gauge, PVC Coated.

2.06 Site Railings
A. Rails and Posts: 1½” diameter galvanized steel tube rails and posts.

B. Brackets: for attaching handrails to rail posts, utilize self-leveling brackets, prime and paint, colors for rails, posts and brackets to be selected by Architect.

2.07 View Rails

A. Vertical wood posts 8” diameter pressure treated Southern Pine, No. 2 grade or better.

B. Horizontal wood rails 6” diameter pressure treated Southern Pine, No. 2 grade or better.

C. Vertical wood pickets 1 ¾” - 2” diameter pressure treated Eucalyptus.

D. Rope: Polyester rope, as manufactured by International Cordage, Phoenix, Arizona, 85034, 800-920-1474, Safari Thatch, or approved equal. Color to be selected by Architect.

E. Paint: See Section 09900 for staining and sealing, color to be selected by Architect

2.08 Boma Exclusion Fence and Kick Rail

A. Wood posts and rails: pressure treated Southern Pine, No. 2 grade or better.

B. Vertical wood pickets 1 ¾” - 2” diameter pressure treated Eucalyptus.

C. Rope: Polyester rope, as manufactured by International Cordage, Phoenix, Arizona, 85034, 800-920-1474, Safari Thatch, or approved equal. Color to be selected by Architect.

D. Paint: See Section 09900 for staining and sealing, color to be selected by Architect

3. EXECUTION

3.01 Site Preparation

A. The fencing, gates, railings and accessories shall be installed in strict accordance with plans and specifications in a workman-like manner by skilled mechanics, experienced in erection of this type of fence and railings.

B. Contractor shall coordinate installation of all fences and railings with landscape/irrigation contractor prior to installation. Stake center of each post and receive written approval from Architect prior to installation. Spacing shall be adjusted to avoid damage to existing tree roots.

C. Contractor is responsible for all temporary barricades, enclosures and protection of adjacent property and existing work. These are to be in place before operations are started. Coordinate this work with other work and trades. Complete clearing and site preparation work is required prior to commencement

3.02 Chain Link Construction Fence Construction

A. Post:
   1. Auger holes for post footings in firm, undisturbed or compacted soil. Holes for new post footings shall be direct bury for line posts and 14 inches diameter for terminal, pull posts and
gateposts, and shall be 5’ deep minimum.
2. Excavate hole depths 3” deeper than post bottom.
3. Place concrete around posts in a continuous placement, tamp for consolidation, check each post for vertical and top alignment. Anchor post plumb until concrete has cured. Set keepers, stops, sleeves and other accessories into concrete as required.
4. The top exposed surface of the concrete footing shall be flush with finished grade and sloped from the bottom of the post to provide a neat appearance and shed water. Top of footing shall appear true and circular in shape with post at center of circle. Fencing fabric shall not be stretched until at least seven (7) days after the posts are set in concrete.
5. Stretches of fence shall be 50 feet maximum in length. Corner posts shall be installed at all points of deflection greater than 30 degrees in the line of fence and where there are abrupt changes in grade of 30 degrees. All post tops shall be securely fastened to posts to prevent removal.

B. Install Tension/Stretcher Bars on all four sides between each vertical posts and top and bottoms rails for chainlink barrier fences.

C. Fabric: Pull fabric taut and tie to tension/stretchers. Install fabric to align with centerline of posts and rails.

D. Knuckle fabric cleanly at all sides to eliminate sharp projections.

E. Wire ties: The fabric shall be securely fastened to the line posts by means of #7 gauge galvanized steel wire, spaced approximately on twelve (12) inch centers.

3.03 Chain Link Construction Gate Construction

A. No openings between frame or gate members shall exceed 2 inches. No gap between bottom rail and finish grade shall exceed 2 inches.

B. Plunger fastener shall be welded to the plunger and galvanized after welding.

C. Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete for anchorage. For double gates, each half shall be level and lined up with the other, and lined up with at least one adjacent top rail. Adjust hardware for smooth operation and lubricate where necessary. After Architect’s approval of operation, drill, tap and set screw or spot weld all hinges and latch hardware to prevent rotation.

D. Set gate post same as terminal posts.

3.05 Chain Link Barrier (Hoofstock) Fence Construction

A. Post:
   1. Auger holes for post footings in firm, undisturbed or compacted soil. Holes for new post footings shall have a diameter of 18 inches for line posts and 30 inches for end, corner and gate posts, and shall be 6’-8” deep for line posts, and 12’ for end, corner, and gate posts.
   2. Install epoxy coated reinforcing per detail.
   3. Excavate hole depths 3” deeper than post bottom. Place concrete around posts in a continuous placement, tamp for consolidation, and check each post for vertical and top alignment. Anchor post plumb until concrete has cured. Set keepers, stops, sleeves and other accessories into concrete as required.
   4. The top exposed surface of the concrete footing shall be flush with finished grade and sloped from the bottom of the post to provide a neat appearance and shed water. Top of footing shall appear true and circular in shape with post at center of circle. Fencing fabric shall not be stretched until at least seven (7) days after the posts are set in concrete.
5. Stretches of fence shall be 50 feet maximum in length. Corner posts shall be installed at all points of deflection greater than 30 degrees in the line of fence and where there are abrupt changes in grade of 30 degrees. All post tops shall be securely fastened to posts to prevent removal.

B. Install Tension/Stretcher Bars/Bands on all sides between each vertical posts and top and bottoms rails for chainlink barrier fences.

C. Install cable and tension.


E. Knuckle fabric cleanly at all sides to eliminate sharp projections.

F. Wire ties: The fabric shall be securely fastened to the line posts or cable by means of #7 gauge vinyl coated steel wire, spaced approximately on twelve (12) inch centers.

3.06 Exclusion Fence and Gate, Site Railings, View Rails, and Boma Barriers

A. Install to the details and requirements of the Drawings.

3.07 Electrical Coordination

A. Coordinate all locations of electrical cut outs with requirements of electrical construction.

3.08 Clean-Up

A. Job site shall be cleared of all excess material (concrete, wire, rails, pipe, etc.). All areas impacted by construction shall be leveled, raked of all debris and rocks and restored to original condition.

END OF SECTION
SECTION 02832 - SEGMENTAL RETAINING WALL SYSTEMS

1. **GENERAL**

1.01 **Description**

A. Work includes furnishing and installing segmental retaining wall (SRW) units to the lines and grades designated on the project’s final construction drawings or as directed by the Architect/Engineer. Also included is furnishing and installing appurtenant materials required for construction of the retaining wall as shown on the construction drawings.

1.02 **Reference Standards**

A. Segmental Retaining Wall Units

1. ASTM C 1372 - Standard Specification for Segmental Retaining Wall Units
2. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units

B. Geosynthetic Reinforcement

1. ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method
2. ASTM D 5262 - Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics
3. GRI:GG1 – Single-Rib Geogrid Tensile Strength
4. GRI:GG5 - Geogrid Pullout

C. Soils

1. ASTM D 698 - Moisture Density Relationship for Soils, Standard Method
2. ASTM D 422 - Gradation of Soils
3. ASTM D 424 - Atterberg Limits of Soil

D. Drainage Pipe

1. ASTM D 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe
2. ASTM D 1248 - Specification for Corrugated Plastic Pipe

E. Engineering Design


F. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of applicable document.

1.03 **Submittals**

A. Materials Submittals: The Contractor shall submit manufacturers’ certifications stating that the SRW units and geosynthetic reinforcement meet the requirements of Section 2 of this specification.

B. Design Submittal: The Contractor shall submit detailed design calculations and final retaining wall plans for approval prior to the beginning of wall construction. All calculations and drawings shall be prepared and sealed by a professional Civil Engineer (P.E.) - (Wall Design Engineer) experienced in SRW design and licensed in AL.
1.04 Delivery, Storage and Handling

A. Contractor shall check materials upon delivery to assure that specified type and grade of materials have been received and proper color and texture of SRW units have been received.

B. Contractor shall prevent excessive mud, wet concrete, epoxies and like materials that may affix themselves from coming in contact with materials.

C. Contractor shall store and handle materials in accordance with manufacturer's recommendations.

D. Contractor shall protect materials from damage. Damaged materials shall not be incorporated into the retaining wall.

2. MATERIALS

2.01 Segmental Retaining Wall Units

A. SRW units shall be machine formed, Portland cement concrete blocks specifically designed for retaining wall applications. SRW units currently approved for this project are:

Retaining Wall Units as manufactured by: VERSA-LOK, “Standard” SRW Unit, 6”Hx16”W face x 14”W back x 12”D, or approved equal.

B. Color of SRW units shall be determined by Architect.

C. Finish of SRW units shall be split-face.

D. SRW unit faces shall be of straight geometry.

E. SRW unit height shall be 6 inches.

F. SRW units (not including aggregate fill in unit voids) shall provide a minimum weight of 105 psf wall face area.

G. SRW units shall be solid through the full depth of the unit.

H. SRW units shall have a depth (front face to rear) to height ratio of 2:1, minimum.

I. SRW units shall be interlocked with connection pins, designed with proper setback to provide 8:1 vertical-to-horizontal batter (a 7-degree cant from vertical).

J. SRW units shall be capable of being erected with the horizontal gap between adjacent units not exceeding 1/8 inch.

K. SRW units shall be capable of providing overlap of units on each successive course so that walls meeting at corner are interlocked and continuous. SRW units that require corners to be mitered shall not be allowed.

L. SRW units shall be capable of providing a split-face, textured surface for all vertical surfaces that will be exposed after completion of wall, including any exposed sides and backs of units.

M. SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the
structure. Cracking or excessive chipping may be grounds for rejection. Units showing cracks longer than ½ inch shall not be used within the wall. Units showing chips visible at a distance of 10 feet from the wall shall not be used within the wall.

N. Concrete used to manufacture SRW units shall have a minimum 28 days compressive strength of 3,000 psi and a maximum moisture absorption rate, by weight, of 8% as determined in accordance with ASTM C1372. Compressive strength test specimens shall conform to the saw-cut coupon provisions of ASTM C140.

O. SRW units’ molded dimensions shall not differ more than ± 1/8 inch from that specified, in accordance with ASTM C1372.

2.02 Segmental Retaining Wall Unit Connection Pins

A. SRW units shall be interlocked with VERSA-Tuff connection pins. The pins shall consist of glass-reinforced nylon made for the expressed use with the SRW units supplied.

2.03 Geosynthetic Reinforcement

A. Geosynthetic reinforcement shall consist of geogrids or geotextiles manufactured as a soil reinforcement element. The manufacturers/suppliers of the geosynthetic reinforcement shall have demonstrated construction of similar size and types of segmental retaining walls on previous projects. The geosynthetic type must be approved one week prior to bid opening. Geosynthetic types currently approved for this project are:

VERSAR-Grid Geogrids

B. The type, strength and placement location of the reinforcing geosynthetic shall be as determined by the Wall Design Engineer, as shown on the final, P.E.-sealed retaining wall plans.

2.04 Leveling Pad

A. Material for leveling pad shall consist of compacted sand, gravel, or combination thereof (USCS soil types GP, GW, SP, & SW) and shall be a minimum of 6 inches in depth. Lean concrete with a strength of 200-300 psi and 3 inches thick maximum may also be used as a leveling pad material. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

2.05 Drainage Aggregate

A. Drainage aggregate shall be angular, clean stone or granular fill meeting the following gradation as determined in accordance with ASTM D422

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
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<tbody>
<tr>
<td>1 inch</td>
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<tr>
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<td>75-100</td>
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<td>0-60</td>
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<td>No. 40</td>
<td>0-50</td>
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<tr>
<td>No. 200</td>
<td>0-5</td>
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2.06 Drainage Pipe

A. The drainage collection pipe shall be a perforated or slotted PVC, or corrugated HDPE
pipe. The drainage pipe may be wrapped with a geotextile to function as a filter.

B. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

2.07 Reinforced (Infill) Soil

A. The reinforced soil material shall be free of debris. Unless otherwise noted on the final, P.E.-sealed, retaining wall plans prepared by the Wall Design Engineer, the reinforced material shall consist of the inorganic USCS soil types GP, GW, SW, SP, SM, meeting the following gradation, as determined in accordance with ASTM D422:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
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<tr>
<td>4 inch</td>
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<tr>
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<td>20-100</td>
</tr>
<tr>
<td>No. 40</td>
<td>0-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-35</td>
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</tbody>
</table>

B. The maximum particle size of poorly-graded gravels (GP) (no fines) should not exceed 3/4 inch unless expressly approved by the Wall Design Engineer and the long-term design strength (LTDS) of the geosynthetic is reduced to account for additional installation damage from particles larger than this maximum.

C. The plasticity of the fine fraction shall be less than 20.

3. DESIGN PARAMETERS

3.01 Soil

A. Per Geotechnical Engineer's Report.

B. Should the actual soil conditions observed during construction differ from those assumed for the design, design shall be reviewed by the Wall Design Engineer at the Owner's Geotechnical Engineer's direction.

3.02 Design

A. While vertical spacing between geogrid layers may vary, it shall not exceed 2.0 feet maximum in the wall design.

B. The geosynthetic placement in the wall design shall have 100% continuous coverage parallel to the wall face. Gapping between horizontally adjacent layers of geosynthetic (partial coverage) will not be allowed.

4. CONSTRUCTION

4.01 Inspection

A. The Owner or Owner's Representative is responsible for verifying that the Contractor meets all the requirements of the specification. This includes all submittals for materials and design, qualifications, and proper installation of wall system.
B. Contractor's field construction supervisor shall have demonstrated experience and be qualified to direct all work at the site.

4.02 Excavation

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Engineer/Architect, at the Contractor's expense.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor.

4.03 Foundation Preparation

A. Following the excavation, the foundation soil shall be examined by the Owner's Representative to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Owner's Representative.

B. Foundation soil shall be proof-rolled and compacted to 95% standard Proctor density and inspected by the Owner's Representative prior to placement of leveling pad materials.

4.04 Leveling Pad Construction

A. Leveling pad shall be placed with a minimum thickness of 6 inches. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

B. Granular leveling pad material shall be compacted to provide a firm, level bearing surface on which to place the first course of units. Well-graded sand can be used to smooth the top 1/4 inch to 1/2 inch of the leveling pad. Compaction will be with mechanical plate compactors to achieve 95% of maximum standard Proctor density (ASTM D 698).

4.05 SRW Unit Installation

A. All SRW units shall be installed at the proper elevation and orientation as shown on the final, P.E.-sealed wall plans and details or as directed by the Wall Design Engineer. The SRW units shall be installed in general accordance with the manufacturer's recommendations. The specifications and drawings shall govern in any conflict between the two requirements.

B. First course of SRW units shall be placed on the leveling pad. The units shall be leveled side-to-side, front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad. The first course is the most important to ensure accurate and acceptable results. No gaps shall be left between the front of adjacent units. Alignment may be done by means of a string line or offset from base line to the back of the units.

C. All excess debris shall be cleaned from top of units and the next course of units installed on top of the units below.

D. Two VERSA-Tuff connection pins shall be inserted through the pin holes of each upper-course unit into receiving slots in lower-course units. Pins shall be fully seated in the pin slot below. Units shall be pushed forward to remove any looseness in the unit-to-unit connection.
E. Prior to placement of next course, the level and alignment of the units shall be checked and corrected where needed.

F. Layout of curves and corners shall be installed in accordance with the wall plan details or in general accordance with SRW manufacturer’s installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.

G. Procedures C. through F. shall be repeated until reaching top of wall units, just below the height of the cap units. Geosynthetic reinforcement, drainage materials, and reinforced backfill shall be placed in sequence with unit installation as described in Section 4.06, 4.07 and 4.08.

4.06 Geosynthetic Reinforcement Placement

A. All geosynthetic reinforcement shall be installed at the proper elevation and orientation.

B. At the elevations shown on the final plans, (after the units, drainage material and backfill have been placed to this elevation) the geosynthetic reinforcement shall be laid horizontally on compacted infill and on top of the concrete SRW units, to within 1 inch of the front face of the unit below. Embedment of the geosynthetic in the SRW units shall be consistent with SRW manufacturer’s recommendations. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor to be in accordance with the geosynthetic manufacturer’s recommendations. The highest-strength direction of the geosynthetic must be perpendicular to the wall face.

C. Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Splicing of the geosynthetic in the design-strength direction (perpendicular to the wall face) shall not be permitted. Along the length of the wall, horizontally adjacent sections of geosynthetic reinforcement shall be butted in a manner to assure 100% coverage parallel to the wall face.

D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6 inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds (less than 5 mph).

E. The geosynthetic reinforcement shall be free of wrinkles prior to placement of soil fill. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by 6 inches of fill.

4.07 Drainage Materials

A. Drainage aggregate shall be installed to the line, grades and sections shown on the plans. Drainage aggregate shall be placed to the minimum thickness (a minimum of 1 cubic foot for each exposed square foot of wall face unless otherwise noted on the final wall plans).

B. Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced-soil zone. The drainage collection pipe shall daylight into a storm sewer or along a slope, at an elevation lower than the lowest point of the pipe within the aggregate drain.
4.08 Backfill Placement

A. The reinforced backfill shall be placed as shown in the final wall plans in the maximum compacted lift thickness of 10 inches and shall be compacted to a minimum of 95% of standard Proctor density (ASTM D 698) at a moisture content within 2% of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.

B. Only hand-operated compaction equipment shall be allowed within 3 feet of the back of the wall units. Compaction within the 3 feet behind the wall units shall be achieved by at least three passes of a lightweight mechanical tamper, plate, or roller.

C. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing and reinforced backfill to direct water runoff away from the wall face.

D. At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary grading and drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

4.09 SRW Caps

A. SRW caps shall be properly aligned and glued to underlying units with VERSA-LOK adhesive, a flexible, high-strength concrete adhesive. Rigid adhesive or mortar are not acceptable.

B. Caps shall overhang the top course of units by 3/4 inch to 1 inch. Slight variation in overhang is allowed to correct alignment at the top of the wall.

4.10 Construction Adjacent to Completed Wall

A. The Owner or Owner's Representative is responsible for ensuring that construction by others adjacent to the wall does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading. Heavy paving or grading equipment shall be kept a minimum of 3 feet behind the back of the wall face. Equipment with wheel loads in excess of 150 psf live load shall not be operated within 10 feet of the face of the retaining wall during construction adjacent to the wall. Care should be taken by the General Contractor to ensure water runoff is directed away from the wall structure until final grading and surface drainage collection systems are completed.

END OF SECTION
SECTION 02930 - LANDSCAPE WORK

1. GENERAL

1.01 Section Includes

A. The following work to be completed by the Contractor includes but is not limited to:
   1. Accepting topsoil/soil mix placement and grades. Placement and testing of soil mixes by separate Contractor.
   2. Locate all utilities in preparation for installation of plant material.
   3. Providing and installing geotextiles and erosion control measures where required.
   4. Providing, installing, maintaining and guaranteeing all plant material, including seeding.
   5. Mulching.
   6. Special cleanup for Exhibit Areas.

1.02 Related Sections

A. Section 02220 – Selective Site Demolition: Identified trees that are to remain or be stockpiled for work of this Section. Protection of existing tree root zones.

B. Section 02230 - Site Clearing.

C. Section 02300 - Earthwork: Excavation work, aggregate materials, soil mix installation.

D. Section 02370 – Erosion Control.

1.03 Quality Assurance

A. Testing: Laboratory testing for suitable soil amendments and fertilizer.

B. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction. The following publications of the issues listed below, but referred to hereafter by basic designation only, form a part of this specification to the extent designated by references thereto:
   2. Federal Seed Act: United States Department of Agriculture (USDA) Publication: Federal Seed Act, August 9, 1939, as amended April 1968 (Copies available through Seed Branch, Grain Division, Agricultural Marketing Services USDA Beltsville, Maryland).
   3. All plants will conform to the current issue of the American Standard for Nursery Stock published by the American Association of Nurserymen.
   4. All plant material shall comply with the State and Federal laws, including quarantines, with respect to inspection, plant diseases and insect infestation.
   5. Nomenclature will be in accordance with Hortus III.

C. Qualifications of Workers

1. Journeyman Supervision: NOTE: The Owner expects the highest professional standards in the site preparation, handling, planting and maintenance of plant materials and related work in this project. Provide at least one person present at all times during execution of this portion of the work who is thoroughly familiar with the type of materials being installed and the proper materials and methods for their installation, to direct all work performed under this Section. This person shall have a minimum of 7 years experience in work similar to those specified. Contractor shall provide an accurate resume of the Journeyman Supervisor to the Owner's Representative for approval as proof of experience. The Journeyman Supervisor must be able to communicate clearly with the workers under his/her supervision and be familiar with Latin nomenclature of common nursery stock.
   2. Equipment:
a. Provide machinery and equipment necessary for the prompt, professional completion of the work. Such machinery and equipment shall be adequate to the task required and shall be operated by a person skilled and experienced in both operation of the equipment and the implementation of the task.
b. Upon request, promptly furnish satisfactory evidence of the organization and equipment to be made available for the performance of the work.
c. Comply with all Federal and State Department of Agriculture regulations for plant pest control which, in general, requires that contractors operating in infested areas thoroughly clean all equipment units before moving them to non-infested areas. Full information can be obtained from appropriate Regulating Agencies.
d. Comply with OSHA requirements.

D. Agronomist or Soil Scientist (Agronomist): The Owner may employ an Agronomist to review subsoil and soil mix test results and make recommendations accordingly. Contractor shall allow for time for Agronomist to review tests and make recommendations for Contractor to incorporate.

1.04 Submittals

A. General: Comply with submittal procedures and requirements of Division 1.

B. Materials Lists: Within 45 days after award of the Contract, submit a complete list of all materials proposed to be furnished or relocated and installed (including sources) under this Section, demonstrating conformance with the requirements specified.

C. Schedule: Within 45 days after award of the Contract, submit a site schedule for Owner approval indicating schedule for all grading, soil mix placement, plant material, mulch, seeding, geotextile fabric placement and erosion control measures.

D. Certificates and Soil Test results:
   1. Deliver all certificates and soil test results to the Owner's Representative including Material Safety Data Sheets.
   2. Deliver to the Owner's Representative certificates demonstrating freedom from disease and seed quality certification.
   3. The Contractor must submit to the Owner's Rep. a letter of certification from the supplying nurseries that plants supplied to the contractor conform to the requirements listed in this Specification. This certification must be received at least ten (10) days before plants are delivered to the site.
   4. Deliver Material Safety Data Sheets for all soil amendments, herbicides or any other toxic substances included in this section.

E. Samples: Submit samples with written certification of compliance, of the following materials at least 30 days prior to beginning work covered in this section.
   1. Fertilizers
   2. Soil Mixes
   3. Stakes and Tree Support System
   4. Plant materials, confirming size, number and source

1.05 Scheduling of Work and Notification of Owner

A. Contractor shall arrange a pre-procurement meeting with the Owner's Representative prior to purchasing any plant material for the project.

B. Contractor shall arrange a pre-construction meeting with the Owner's Representative prior to the beginning of the landscape work specified in this section.
C. The site has limited storage and mobilization area. Contractor shall keep Owner informed regarding schedule and all plant material arriving on site.

1.06 Product Handling

A. Documentation: Submit documentation to Owner’s Representative at least 30 days prior to start of work under this Section that all plants have been ordered.

B. Material Storage: Store products with protection from weather or other conditions, which would damage or impair the effectiveness of the product.

C. Plant Handling and Plant Relocation: All plants shall be packed and protected in such a manner as to insure adequate protection against climatic, seasonal transportation, and other injuries. Unloading and relocating shall be carefully done to prevent mechanical injury to plants. Mechanical damage to plants is sufficient justification for plant rejection. Immediately after delivery, all balled plants shall be set on the ground and the balls well protected with soil or mulch. All plants shall be watered and properly maintained until planting, in shade to the satisfaction of the Owner’s Representative.

D. Out-of-State Sources: The Contractor is responsible for the location, transportation, and legal admittance to the State of New York from throughout the United States.

2. PRODUCTS

2.01 Plants

A. General: All plants shall be the kind and size indicated on the plant list and shall be true to name. All plants shall be sound, healthy, vigorous, pest free nursery stock with a normal habit of growth (unless otherwise specified by Architect), shall have been subjected to nursery root and top spraying, transplanting, etc., and shall have been inspected and approved for sale, transporting and transplanting by all governmental agencies authorized to administer such control.

Should the need arise for plants to be tagged in the field prior to delivery, the Owner shall be notified as per Paragraph 1.05.A and shall complete tagging during one (1) scheduled nursery visit.

All plants shall be subject to inspection and approval by the Architect and/or the Owner’s Representative throughout contract period. The Contractor must submit to the Owner’s Representative a letter of certification from the supplying nurseries that plants supplied to the contractor conform to the requirements listed in this paragraph. This certification must be received at least ten (10) days before plants are delivered to the site.

B. Plants shall be true to measurement specified except that plants larger than specified may be used if approved by the Owner’s Representative at no additions to the Contract Price. Plant size to be determined according to most recent edition of American Standard for Nursery Stock.

C. Substitutions of plants will not be permitted unless reviewed and approved in writing by the Architect and Owner prior to commencement of the work.

D. Boxed balled and burlap stock shall be dug with firm natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary to the plant’s full recovery. Root balls shall be firmly wrapped with burlap and bound with twine or wire mesh. There shall be no polypropylene or treated burlap used on this Project.
E. Container stock shall have been grown in its delivery container for not less than six (6) months but not more than two (2) years. Deliveries will be monitored and non-suitable materials shall be rejected and replaced by the Contractor at no additional cost.

F. Herbaceous Plants: All herbaceous plants must be adequately containerized, packaged, etc. to insure viability of plants and the protection of roots and other plant parts against climatic, seasonal and other injuries.

G. Grass Seed: Seed shall be certified with no less than 90% purity and a total weed seed percentage not exceeding 1% of the mixture. Minimum germination to be 90%.
   1. Exhibit Seed Mix: See Planting Schedule on Drawings
   2. Site Seed Mix: See Planting Schedule on Drawings
   3. Coordinate seeding schedules with Owner’s Representative

H. Grass Plugs: N/A

2.02 Topsoil

A. The Contractor shall utilize and incorporate existing on-site topsoil into soil mixes and supplement with additional topsoil as necessary to complete the work in accordance to plans. If additional topsoil is required, the Contractor shall import topsoil, meeting the below requirements, at no additional cost to the Owner.

B. Standard Soil Test (C.S.U.) shall be performed by a state certified testing lab on all on-site topsoil and any imported topsoil and approved by the Owner’s Representative before soil is delivered to site. It shall be the contractor’s responsibility to schedule testing in a timely fashion to: allow for results to be reviewed and approved by contractor and Owner’s Representative so as not to disrupt the schedule of work; allow for additional amendments to be incorporated into the soil mix as requested by Owner’s Representative in response to reviewed soil tests, and retesting of amended soil mix for compliance with specifications. Topsoil shall be natural friable homogenous loam or sandy loam soil capable of sustaining normal plant growth. It shall have a PH between 6 and 7, and shall contain no more than 20% clay and between 20%-25% of organic matter, as determined by loss on ignition of oven-dried samples. Soluble salts shall not exceed 500 parts per million.

C. Topsoil shall be free from any subsoil, clods or clay lumps, brush, weeds, stumps or roots, stones or construction debris larger than 1/4” in diameter, toxic substances, and any other material or substance which may be harmful to plant growth or be a hindrance to planting and maintenance operations.

2.03 Soil Amendments (As Recommended by Standard Soil Test to be Performed by the Contractor)

A. Dolomite Lime: Shall be agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing No. 65 sieve, Kaiser Dolomite 65 AG or approved equal.

B. Compost: Shall be 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 1/2-inch (13-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; organic matter Content: 50 to 60 percent of dry weight.

C. Fertilizer: Use 100% natural, slow release bio-fertilizers. It should be uniform in composition, dry and free flowing and shall be delivered to the site in the original unopened containers, each
bearing the manufacturer's guaranteed analysis. Fertilizer that becomes caked or otherwise damaged will not be accepted.

1. Plants: Organic Slow Release Fertilizer (4 – 0 – 4).

D. Sand: Graded sand base consist of natural river or bank sand; washed, free of silt, clay, loam, friable or soluble materials, or organic matter, graded to the following limits:

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<th>Sieve Size</th>
<th>Percent Passing</th>
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<tbody>
<tr>
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<td>10% to 100%</td>
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<td>5% to 90%</td>
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<td>No. 100</td>
<td>4% to 30%</td>
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<tr>
<td>No. 200</td>
<td>0%</td>
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</tbody>
</table>

E. Peat Moss: Type 1 sphagnum peat moss; finely divided with a pH of 3.1 to 5.0, free from weeds or other materials harmful to plant growth.

F. Aluminum Sulfate: Commercial grade.

G. Superphosphate: No phosphate to be used Soluble mixture of treated minerals: 20 percent available phosphoric acid.

2.04 Soil Mixes

A. Soil mixes shall be blended mechanically using commercial mixer or shredder. Ingredients shall be uniformly incorporated to obtain a consistent blend.

B. Protect soil mix stockpiles after mixing from erosion, saturation, or weed growth using plastic sheeting or tarps.

C. Prior to mixing any planting mix, prepare sample mix ratios and submit to the Owner for approval along with test results. If the sample does not meet the mix criteria, resubmit alternative mix ratio samples with test results.

D. Provide the following soil mixes where indicated on the Drawings. Soil mixes, including amendments, must be completely mixed prior to placement.

1. Soil Mix #1 - Exhibit Seeding:
   a) Place no soil mix until subgrade has been approved. Scarify or plow existing soil to a minimum depth of 6” (DO NOT DISTURB SOIL WITHIN THE DRIPLINES OF EXISTING TREES TO REMAIN). Remove vegetation and foreign inorganic material.
   b) Place 24” of soil mix on loosened soil and roll lightly with appropriate lawn roller to consolidate soil mix.
   c) Soil mix ingredients to be thoroughly mixed to a uniform consistency for the full 24” depth.
   d) Soil mix to be composed of:
      - 40% crushed granite, maximum dimension 3/4”
      - 50% topsoil (from on-site or imported)
      - 10% compost with neutral pH in the range of 5.25 to 6.5
   e) Place soil mix to promote good drainage (per grading plans) and compact with light roller not to exceed 85% where structural compaction is not required.
   f) Overall soil mix shall have a neutral pH range of 6 to 7, which will be confirmed by an analysis of the mix by an accredited soils laboratory, provided at the Contractor’s cost.
   g) Water soil mix after placement until saturated for a minimum depth of 6”. Fill in and re-compact areas of settlement.
2. **Soil Mix #2 - Exhibit Planting:**
   a) 9” depth.
   b) Soil Mix shall be composed of 75% topsoil, 25% sand, compaction of subsoil up to additional 1'-6" not to exceed 85% where structural compaction not required.
   c) It shall be mixed dry to a uniform texture without lumps and containing no stones, sticks, roots or other foreign material. Mix shall have a neutral pH range of 6 to 7, which will be confirmed by an analysis of the mix by an accredited soils laboratory, provided at the Contractor’s cost.
   d) Soil amendments shall be applied and incorporated at amounts and rates determined by the topsoil analysis and manufacturer’s specifications. Subsoil to be thoroughly amended with 3-4 CY of peat moss/1000 SF.

3. **Soil Mix #3 - Site Seeding:**
   a) 6” depth.
   b) Soil for all general planting areas outside of identified soil mixes.
   c) Contractor shall verify with Owner extent of Soil Mix 3 installation prior to commencement of work.
   d) Soil Mix shall be composed of 100% topsoil.
   e) It shall be mixed dry to a uniform texture without lumps and containing no stones, sticks, roots or other foreign material. Mix shall have a neutral pH range of 6 to 7, which will be confirmed by an analysis of the mix by an accredited soils laboratory, provided at the Contractor’s cost.
   f) Soil amendments shall be applied and incorporated at amounts and rates determined by the topsoil analysis and manufacturer’s specifications.

4. **Soil Mix #4 - Site Planting:**
   a) 9” depth.
   b) Soil Mix shall be composed of 75% topsoil, 25% sand, compaction of subsoil up to additional 2'-3" not to exceed 85% where structural compaction not required.
   c) It shall be mixed dry to a uniform texture without lumps and containing no stones, sticks, roots or other foreign material. Mix shall have a neutral pH range of 6 to 7, which will be confirmed by an analysis of the mix by an accredited soils laboratory, provided at the Contractor’s cost.
   d) Soil amendments shall be applied and incorporated at amounts and rates determined by the topsoil analysis and manufacturer’s specifications.
   e) Subsoil to be thoroughly amended with 3-4 CY of peat moss/1000 SF.

5. **Soil Mix #5 - Boma Yard, Corrals, and Off-Exhibit Yards:**
   a) 24” depth.
   b) Mason Sand, clean and free of fines.
   c) High percolation rate, with no binding qualities.

E. The Contractor shall provide soil pH testing of each type of soil mix for a total of five (5) random tests. Materials to be sent to the appropriate agency for analysis. The Contractor shall amend soil mixes as per soil test results.

2.05 **Geo-textile Fabric**
   A. See Section 02370.
   B. Erosion Control Mat: (Slopes) See civil drawings.

2.06 **Mulch**
   A. Wood Mulch: double shredded hardwood (not bark) ranging in size from ¾” to 1½”.

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2.07 Staking Materials

A. Guying: All guying materials are to be sized and installed as per ANSI 300: ISA Best Management Practices/Tree Support Systems. All guying shall be removed one year after installation.

B. Straps: Jute straps, minimum 2-ply.

2.08 Seed Mulching Materials

A. Straw shall be free of rot, mildew and noxious weed seeds and shall be a small grain such as wheat, barley, or oats.

B. Cellulose Fiber Mulch: Shall consist of 100% recycled paper and/or wood waste processed into a uniform fibrous physical state. The mulch, including dye, shall contain no germination or growth inhibiting factors. The mulch material shall be manufactured and processed in such a manner that the cellulose fiber mulch will remain in uniform suspension in water under agitation and will blend with seed, fertilizer and other additives to form a homogeneous slurry. The mulch shall cover and hold grass seed in contact with the soil without inhibiting the growth of the grass seedlings.

3. EXECUTION

3.01 Finish Grading

A. Verification of Subgrade: The Contractor shall verify that sub-grades are accurately established before spreading topsoil and soil mixes. Scarify subgrade (except for within an area equal to 1.25 times the diameter of the dripline underneath existing trees to remain) to depth of 6" and obtain approval from the Zoo of scarified subgrade prior to incorporating topsoil or soil mixes. Remove stones or hard debris larger than 1/4" except where existing tree roots are near the surface.

B. Subsoils: Subsoil under soil mixes to be compacted per the Soil Mix descriptions. Contractor to test soil compaction in each soil mix zone (approximately every 500 SF or as directed by Owner's Representative) to verify compaction % and submit to Owner for approval. Once subsoil condition is approved by Owner, proceed with installation of soil mixes.

C. For subsoils that exceed compaction rates of 85% and that are not required to be higher for structural reasons, break up ground surface to depths identified in Soil Mix descriptions and recompact to 85%. Retest soil compaction as per 3.01B. Once approved by Owner, proceed with installation of soil mixes.

D. Mix 4" of topsoil soil mix with subgrade soil, then apply remaining soil mix.

E. Place soil mixes as follows:
   1. Soil Mixes #2, #4, #5: Shall be placed in 4"-5" lifts and compacted to 85% of maximum density prior to placing successive 4"-5" lift. Install geotextile fabric over sand fill for Soil Mix #5 prior to placing soil mix.
   2. Soil Mixes #1, #3: Shall be placed in one lift. Apply water and compact to 85% of maximum density compaction.

F. Inspection: The scarified sub-grade must be inspected and approved by Owner before placement of soil mix commences.

G. Confirmation of finish grades: In all planted areas a layer of planting soil shall be placed as called for so the bed surface will be at the specified finish grade when mixture has settled to
normal compaction. Grades shall be true to line, fair to curvature and accurate to grades as shown on drawings and directed by the Architect. Finish grades are measured from the top of the finished soil mix including mulch.

H. Soil Mix Surface Friability: All areas to be seeded left for more than 7 days shall be loosened and made friable by raking or as directed by Owner's Representative.

I. Depth of Mulch: Wood mulch shall be uniformly 3 inches thick above finished topsoil grade in all planted areas, not including seeded areas. Mulch to be provided and installed by Contractor.

3.02 Planting

A. The Contractor will conduct all planting work. Provide necessary access and coordinate the work with all other construction activities.

B. Layout:
   1. General: The Planting Plan indicates plant location. The Contractor shall stake the location of all individual trees and shrubs for approval of the Owner's Representative.

C. General:
   1. Planting Season: Plant only during periods that are normal to such work, as determined by season, weather conditions and accepted practice. Owner will make decisions on questions as to when something should be planted.
   2. Fertilizer: Fertilizer shall be applied at the time of planting as follows:
      a. New trees, shrubs, vines, groundcovers, and herbaceous material shall receive slow release 4-7-4 as per manufacturer's specifications.

D. Excavation of Plant Pits: All plant pit excavation shall be according to the following requirements:
   1. If during excavation, an existing root 1-1/2" or larger in diameter is discovered, the Owner's Representative shall be notified to determine whether any modifications to the Planting Plan are required.
   2. Trees with a ball of earth less than four (4) feet in diameter shall be planted in a pit two (2) times as wide as the diameter of the root ball.
   3. In no case shall the distance from the ball to the side of the pit be less than twelve (12) inches. The minimum depth of pits for shrubs shall be twelve (12) inches.
   4. Perennial Planting areas shall be excavated to a depth of six (6) inches.
   5. Groundcover areas shall be excavated to a depth of six (6) inches.
   6. No plant pits shall be dug until the proposed locations have been approved by the Owner's Representative.
   7. All sides and bottoms of plant pits shall be thoroughly scarified before planting to allow for adequate drainage. The Contractor is responsible for providing adequate drainage to maintain healthy plant growth of the specified plants.

E. General Tree, Shrub, Vines, Groundcover, and Perennial Planting:
   1. Prepare plant:
      a. Container grown plants should be removed from the container. Important - rough up the outer part of the rootball so all root tips are loosened from the soil (do not cut roots). Remove pinning nails from plants. Any soil falling from the root mass should be mixed with existing soil to backfill hole. Set plant in hole with root flare at grade.
      b. Balled and burlapped plants should be set in hole ¼" higher than the existing grade. Cut off top of basket bending down cut ends to prevent injury to people and plant. Remove pinning nails from plants. Untie the string around trunk and remove. Remove burlap entirely. If root ball is cracked, crumbling or broken, the plant must be rejected.
   2. Backfill the hole with material excavated from plant pit, making sure the clumps are broken up for plants. Remove any air pockets by gently tamping the soil. Do not compact the soil.
3. Water slowly and thoroughly immediately. Water as required through the growing season to maintain plants in a vigorous growing condition. If drought occurs, water as allowable by law. It is the Contractor's responsibility to water plants until final acceptance is certified per the General Conditions.

4. Cover planting area with 3 inches of mulch starting 1 inch away from the trunk. Do not put mulch against trunk. Do not prune any healthy branches or leaves for at least 1 year unless instructed so by Owner.

F. Hydroseeding:

1. Hydroseeding shall be performed utilizing the Hydraulic Method. Seed, fertilizer and wood fiber mulch material shall be mixed in the specified amount of water and applied under pressure at the rates requested. Spray the area with a uniform visible coat, using the dark color of the cellulose fiber as a visual guide. Apply in a downward drilling motion with a fan stream nozzle. Allow for the surface to percolate water. Reseed all areas that fail to provide a uniform stand of grass with the specified materials until accepted by Owner. Protect from damage.


H. Finishing Planting Areas:

1. All planting areas shall be raked to a smooth even finish conforming to the grading plan. All extraneous materials greater than 1/4" in size and all construction materials such as nails, wire, etc., shall be removed from the site.

2. All watering saucers shall be properly shaped, leaving the entire area in a neat, well-finished condition.

3. Mulching: Cover all planting areas with mulch to a uniform loose depth of two inches, taking care not to cover small ground cover plants. Keep mulch back 1" from tree trunk.

4. Pruning: Trees and shrubs shall be pruned only by the Owner.

3.03 Erosion Control Blanket

A. See Section 02370.

3.04 Clean Up, Protection and Maintenance

A. Clean up the work area and leave in a neat orderly condition and remove debris on a daily basis.

B. Protection: All reinforced slopes and finish grades shall be properly protected against harm resulting from Contractor work. All plantings and grass areas shall be properly protected against harm resulting from Contractor work. No work shall be performed in, over or adjacent to planting areas without proper protection and safeguards. No spraying with toxic substances shall be permitted without written approval from the Owner's Representative.

C. Maintenance: The Contractor shall perform all maintenance of the landscaping work beginning immediately after each plant is planted and extended through the course of the project until the date of provisional acceptance of the work. All plantings that appear to be in distress shall be promptly replaced or replanted as directed by the Owner's Representative or Architect. Work shall include watering, weeding, replacing straw mulch as necessary, repairing watering basins, mowing and all other necessary tasks incidental to the maintenance of healthy growth. Mowing shall be required only in "site seeded" areas outside of exhibits. No spraying with toxic substances shall be permitted without written approval from the Owner's Representative.

D. Maintenance (Site Seeded Areas): Grass shall be maintained at a height of 2-1/2 inches, and shall be cut as needed prior to the beginning of the guarantee period.
3.06 Inspection and Final Acceptance of Plant Material Installed by Contractor

A. The Owner's Representative shall inspect plant material installed by the Contractor for final acceptance sixty (60) days after completing all major planting areas. In the event that the sixty (60) day period expires prior to plant leaf-out, the sixty (60) day period shall be extended at thirty (30) day increments until such time as ALL plant material has leafed-out and can then be inspected. Upon completion of all repairs and renewals which the Owner's Representative deems necessary at this inspection, final acceptance shall be certified in writing by the Owner's Representative.

3.07 Guarantee of Plant Material Installed by Contractor

A. The Contractor's guarantee for the landscaping work shall be for material installed by the Contractor, and shall extend for one year from the date of final acceptance of the work per the General Conditions. At the end of the guarantee period, the Owner's Representative will inspect all plant material. All plants must be in a vigorous growing condition at the end of the guarantee period.

B. Materials determined to be defective at the end of the guarantee period by the Owner's Representative shall be replaced with specimens of the same species and size as the original. Plant material shall be replaced as soon as seasonal and climatic conditions are favorable for planting.

C. Plant guarantee shall not apply to plants damaged by zoo animals, zoo staff, zoo visitors, snow, ice, or other extreme weather events.

C. Reseed grass areas where germination has failed to occur.

3.08 Special Cleanup for Exhibit Areas

A. Note: It is essential that no hard loose materials larger than 1/2" in any dimension be left in any animal area and within six feet of perimeter of exhibits. All metal, wood, plastic, or other construction debris shall be removed from the exhibit. Each contractor shall be responsible for compliance with this requirement for work in his/her area and shall be liable for repair or replacement of work (including exhibit windows) damaged by an animal using objects left within its reach as a result of work in this Section.

END OF SECTION 02930
SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
      1. Footings.
      2. Foundation walls
      3. Slabs-on-grade.
      4. Suspended slabs.
      5. Concrete toppings.
   B. Related Sections include the following:
      1. Division 02 Section "Earthwork" for drainage fill under slabs-on-grade.
      2. Division 02 Section "Exterior Concrete Pavement" for concrete pavement and walks.
      3. Division 02 Section "Stamped Concrete Pavement" for decorative concrete pavement and walks.

1.3 DEFINITIONS
   A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Submittals:
   C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
      1. Indicate amounts of mixing water to be withheld for later addition at Project site.
D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Welding certificates.

F. Field quality-control test and inspection reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5".
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class C

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

1. Products:
   a. Fortifiber Corporation; Moistop Plus.
   b. Raven Industries Inc.; Dura Skrim [6] [8].
   c. Reef Industries, Inc.; Griffolyn Type-[65] [85].
2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:
   a. Axim Concrete Technologies; Cimfilm.
   b. Burke by Edoco; BurkeFilm.
   c. ChemMasters; Spray-Film.
   d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
   e. Dayton Superior Corporation; Sure Film.
   f. Euclid Chemical Company (The); Eucobar.
   g. Kaufman Products, Inc.; Vapor Aid.
   h. Lambert Corporation; Lambco Skin.
   i. L&M Construction Chemicals, Inc.; E-Con.
   j. MBT Protection and Repair, Div. of ChemRex; Confilm.
   l. Metalcrete Industries; Waterhold.
   m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
   n. Sika Corporation, Inc.; SikaFilm.
   o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
   p. UniteX; Pro-Film.
   q. US Mix Products Company; US Spec Monofilm ER.
   r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Water: Potable.

C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:
   a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
   b. Burke by Edoco; Aqua Resin Cure.
   c. ChemMasters; Safe-Cure Clear.
   d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
   e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
   f. Euclid Chemical Company (The); Kurez DR VOX.
   g. Kaufman Products, Inc.; Thinfilm 420.
   h. Lambert Corporation; Aqua Kure-Clear.
   i. L&M Construction Chemicals, Inc.; L&M Cure R.
   k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
   l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
   m. Tamms Industries, Inc.; Horncure WB 30.
   n. UniteX; Hydro Cure 309.
2.8 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types I and II, non-load bearing IV and V, load bearing], for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

E. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
E. Color Pigment: Add color pigment to concrete mixture according to manufacturer’s written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi (20.7 MPa) > at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50
3. Slump Limit: 5 inches (125 mm) >, plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45
3. Slump Limit: 5 inches (125 mm) plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m)
3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m)
3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

E. Building Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45
3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

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

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer’s written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC’s "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

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

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with granular fill moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPs

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.

1. Apply scratch finish to surfaces indicated

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraightening until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm)

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

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

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

3.12 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS
A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer’s written instructions.

3.15 JOINT FILLING
A. Prepare, clean, and install joint filler according to manufacturer’s written instructions.

   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS
A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect’s approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with
patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.
3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
      b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
      a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
      b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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

3.18 FINISH SCHEDULE

A. Floors

1. Exterior paving: broom finish unless noted otherwise
2. Interior exposed concrete floors: broom finish unless noted otherwise
3. Interior surfaces to receive additional finish: trowel finish unless noted otherwise

B. Walls

1. All exposed concrete to be Class A, smooth-form finish. Provide smooth rubbed finish per ACI 301-05 5.3.3.4a. Grind fins smooth, patch/fill tie holes, voids, honeycombs and defects.
2. Unexposed concrete to be Class B.

END OF SECTION 03300
SECTION 03360 - EXHIBIT ROCKWORK AND ARTIFACTS

1. GENERAL

1.01 WORK INCLUDED

A. Work in this section shall be performed by an approved Exhibitry Subcontractor, as defined in this Section, and include all labor, materials, and equipment to excavate, rough grade, finish grade and fabricate the work under this contract which includes the following features as illustrated on the drawings and the Exhibit Rockwork as shown on the drawings.

1. Exterior Shotcrete Fabrications of highly natural appearance, including, but not limited to the following:
   a. Artificial streambeds, beaches and banks.
   b. Artificial geology including rock formations, boulders, and outcrops.
   c. Deep Pools and waterproofing.

2. Concrete, concrete block, and reinforcing required for footings, anchorages, and other structural work for placement of shotcrete and artifacts, not to be performed by other Contractors.

3. Providing Engineering calculations and professionally sealed drawings by a licensed engineer for all work involving structural reinforcing and tie-back anchoring.

4. 6x6 Welded Ground Wire System.

5. Coloring, dying, tinting of new shotcrete rockwork required achieving the required finish.

6. Placement of natural stone boulders used in the exhibit and public areas provided by Owner and installed by Exhibitry Subcontractor.

6. Placement of deadfall used in the exhibit and public areas, deadfall shall be provided by separate Contractor and installed by Exhibitry Subcontractor.

1.02 PRODUCTS INSTALLED UNDER THIS SECTION BUT PROVIDED BY OTHER SECTIONS

A. None

1.03 DEFINITIONS

A. Approved Exhibitry Subcontractor: Subcontractor whose proven experience, qualifications, and methods have been reviewed and accepted for the Work of this Section by CLRdesign inc. and/or the Owner after submitting the required information indicated under the Quality Assurance paragraph of this Section.

B. Artificial Geology (Rockwork/Shotcrete) Definition: Shall consist of the construction and placement of the artificial features indicated on the Drawings and Specifications herein.

C. Carved or Embossed Shotcrete: Shall consist of premixed fine aggregate and cement and water pneumatically placed or applied by suitable mechanism. Texture shall be by hand carving and embossing.

1.04 RELATED WORK

A. AIA Document A201/CMa – General Conditions for Mock-Ups: Specific mock-ups required for Work described in this Section.

B. Section 02300 - Earthwork: Specified fill materials, Aggregate Materials.

C. Section 03300 - Cast-In-Place Concrete
D. Division 15 and 16 – Mechanical, Electrical: Required field coordination of all piping, plumbing, irrigation, and electrical (including ground wire system) with work of this Section.

1.05 QUALITY ASSURANCE - EXHIBITRY SUBCONTRACTOR

A. Experience and Qualification of Bidders: The Exhibitry Subcontractor, in order to qualify as a specially-skilled craftsman for the exhibit rockwork fabrication under this Work, shall demonstrate experience in:

- specializing in the artistic construction of animal exhibit concrete work and pools up to 15’ deep
- coordination of this Work with other trades that affect this Work
- employing qualified and experienced craftspersons/artists, and meeting the following criteria:

The Exhibitry Subcontractor shall submit the following with the bid:

1. A signed statement of experience certifying that the Contractor is an established business with a minimum of 5 years experience and indicate in detail his experience in successfully constructing items described in paragraphs 1.01 and 1.05.

2. Photographic proof and reference material for evaluation of experience and ability to perform under this Work, including photographs (at least five (5) 8-1/2” x 11” color photographs of previous comparable work) to show the Contractor’s capabilities to construct the above mentioned items for natural habitat exhibits similar to those shown on the drawings, and also including a list of completed projects and references which demonstrate these capabilities. These projects and photographs of projects must have been the work of those craftsman and artist proposed for this work.

3. Full documentation of the Construction crew, including resumes of lead personnel (on-site supervisor, and final texturing and finish experts, et al) lists of specific personnel to be used, and details of each listed person’s experience and abilities to perform all phases of construction under this Work to the Architect’s satisfaction. The assigned project on-site supervisor and aesthetic coordinator’s resume should show a minimum of five (5) years experience in the management of project crews of no less than five persons, as well as experience in coordination with other trades in the completion of simulated exhibitry fabrication projects under the Work.

B. The following is a non-restrictive list of pre-qualified Exhibitry Contractors, subject to compliance with the requirements of these specifications:

Cemrock Landscapes, Inc./attn.: Dave Knipe
4798 S. Julian Avenue, Tucson AZ 85714
(520) 571-1999 FAX (520) 571-1888

Cost of Wisconsin, Inc. / attn: Jack Beatty
W172, N13050 Division Road
Germantown, Wisconsin 53022
(800) 221-7625 FAX (414) 255-0096

Rock and Waterscapes Systems, Inc./ attn: Lynette Widmeyer
11 Whatney Road, Irvine, CA  92718
(714) 770-1936 FAX (714) 458-6331

Nassal Company, attn: Matt Brown
415 W. Kaley Street
Orlando, FL  32806-3942
(407) 648-0400
C. Bidders wishing to use other subcontractors under this work should have each proposed subcontractor submit a letter of qualification requirements described above (signed statement of experience, photographic references and project crew documentation), and submit a letter of qualification, including references and at least five (5) 8-1/2" x 11" color photographs of previous comparable work, to the Architect, for review and approval by the Architect and Owner's Representative. Letters of qualification must be received not less than 14 days prior to date for bid opening.

D. Subcontractors wishing to be approved for shotcrete and/or artificial exhibitry fabrication under this work may independently make application directly to the Architect as detailed above.

E. The Architect/Exhibit Designer may require additional information and may request a visit to completed work in order to make a determination of the subcontractor's qualification to produce exhibit artifacts with the required criteria under this Work. The Exhibit Designer may also require a submittal of a high quality color video documentation of completed work.

F. The Owner reserves the right to reject non-qualified subcontractors, based on qualification submittals and, at their option, review of past work and references.

1.06  INTENT

A. It is intended that the work involved create a highly natural appearance of the above-mentioned items as shown on the Drawings and Exhibit Images.

B. The Contractor will perform this work under the direction of the Architect and will be expected to cooperate fully in this process.

C. The Architect explicitly reserves the right to continuously monitor the work for aesthetic quality and functional criteria of the work as it is performed.

D. The Exhibit Contractor is responsible to see that no loose materials used in the execution of this work remain after completion of the project.

1.07  COORDINATION

A. The Exhibitry Subcontractor shall fully coordinate with the other Contractors and their subcontractors and the Architect. If the Exhibit Subcontractor suspects that a conflict may exist between work in this Section and any other work, he/she shall bring the issue to the attention of the Architect before proceeding.

B. Coordinate with all other trades.

1.08  SAMPLES

A. At least thirty days prior to beginning any exhibitry work, the Exhibitry Subcontractor shall deliver to the project site one 4' x 4' or other approved size sample panel for each of the rockwork types listed in the Exhibit Images to the Exhibit Designer for approval. The types are reiterated in the following rockwork type list:
   1. Eroded banks with gravel
   2. Streambeds
   3. Artificial beaches and banks
   4. Artificial geology including outcrops and boulders
C. Samples shall represent finished surfaces with texturing, coloring, etching, etc.

D. Samples rejected by the Architect shall be resubmitted for approval by the Exhibit Subcontractor at no additional cost to the Owner. Sample panels shall not be removed until the completion of the work.

E. At the discretion of the Architect larger sample panels may be installed in their final location and used as part of the final work, if accepted.

1.09 SUBMITTALS

A. All submittals shall be in accordance with AIA Document A201/CMa - General Conditions for Submittals. The Exhibit Subcontractor shall submit the following shop drawings for review:

1. **Layout Plan:** The layout plan shall indicate and identify the following:
   a. All rockwork by indicated categories.
   b. Locations of all required footings and foundations.
   c. Footing and foundation types and all pertinent dimensions.
   d. Tie-back anchorage to resist lateral earth pressures.

2. **Steel Reinforcing:** Indicate signs, types, and location of all steel reinforcing involved in Work of this Section.

3. Provide the seal and signature of a licensed professional Engineer (State of Alabama) to steel reinforcement shop drawings, footings, tie-back anchorages, etc., indicating compliance with all governing codes for reinforced concrete structures. Include structural calculations for all conditions.

4. Literature, Specifications and Mix Designs: Submit all product literature, specifications and mix designs used in the production of rockwork.

5. Imagery: See paragraph 1.10.B. Submit modifications to stated imagery with supplemental imagery if required.

1.10 PRE-CONSTRUCTION CONDITIONS

A. All artificial rockwork locations shall be approved by the Architect/Exhibit Designer prior to actual shotcrete application and texturing.

B. Exhibit Images, and Drawings: The Exhibit Images as provided by Architect indicates all rockwork color ranges, texture types, and respective location. For the purpose of duplicating three dimensionally the design concept and establishing the character, configuration and the amount of simulated rock to be constructed, the Exhibit Subcontractor shall work from drawings and photographs furnished by the Architect/Exhibit Designer. Exhibit Images are considered part of the contract documents.

C. Structural Reinforcement: The structural reinforcement indicated on the plans and in the specifications are to establish minimum design criteria for the Exhibit Subcontractor to incorporate into the rockwork design. The Exhibit Subcontractor shall be responsible to design structural reinforcement for all work in this section and shall provide a licensed structural engineer seal certifying all structural reinforcement sections at no additional cost to the owner. Alternative methods may be recommended for greater cost efficiency. Rockwork shown on the drawings is for "order of magnitude" quantity projections. Rockwork contractor is responsible for providing actual amounts needed within bid price.

D. Methods of Construction: The Exhibit Subcontractor shall submit with bid proposal proposed methods of construction for all work in this section. Such documentation shall include the following:
   1. Statement of understanding of the overall project schedule and required completion of all rockwork and artifacts.
   2. Submit a detailed description of proposed fabrication and finish techniques (including materials) for artificial geology and alternate structural systems (if applicable). Exhibit
subcontractor is responsible for effective waterproofing of all water features including but not limited to all rockwork interfacing with drains, skimmers, walls, etc.
3. Recommend additional cost effective alternative methods of construction prior to start of work for consideration by Architect and Owner.

E. Excavation, Subdrainage and Backfill:
1. The Site Contractor is responsible for the excavation, dewatering, shoring and maintenance of all excavation, subdrainage, wall drainage and aggregate for shotcrete features up to the shotcrete subgrade.
2. The Site Contractor shall be responsible for all additional backforming and backfilling required for shotcrete work as a result of his overexcavation in areas where not required. It is the Site Contractor's responsibility to avoid such overexcavation and to coordinate with the Exhibitry Subcontractor to facilitate excavation as close to final subgrade as possible.
3. The Exhibitry Subcontractor must accept the subgrade in written form for each individual exhibit or portion of an exhibit and submit to the Owner's Representative for approval. If not accepted, the Exhibitry Subcontractor must notify the Owner's Representative in writing immediately.
4. Following the acceptance of the subgrade by the Exhibitry Subcontractor and approval by the Owner's Representative, the Exhibitry Subcontractor shall be responsible for the following at no additional cost to the Owner:
   a. All additional subgrade adjustment and reinstallation of drainage systems and sleeves required for his work.
   b. All maintenance required to maintain the accepted subgrade, with the exception of any dewatering device which shall be the responsibility of the Site Contractor.
5. All backfill behind, around, within and on top of the shotcrete features to complete the rock simulation work to the satisfaction of the Architect shall be the responsibility of the Site Contractor in coordination with the Exhibitry Subcontractor.

1.11 PROJECT SITE CONDITIONS
A. Protection of Property: Take note of requirements for protection of trees and soils as specified. In particular, do not discharge cement-bearing water onto the ground on site except as specifically approved by the Owner's Representative. Account for all debris generated by operations and remove from site regularly, especially small bits of reinforcement and hardware.

B. Surveying:
1. Provide surveying as frequently as is required to accurately locate features as detailed on drawings. Confirm location, elevations and profiles of work by optical or laser survey immediately before and after placement of each contiguous surface.
2. Tolerance for location of any point defined on the drawings in one-tenth of one foot in both horizontal and vertical dimensions.

C. Protection:
1. Be responsible for protection of project materials, including waterproofing susceptible to damage during forming, placing or reinforcement of shotcrete. Provide masks or remove damageable materials before beginning work.

1.12 ARCHITECT/EXHIBIT DESIGNER'S DIRECTION
A. It is intended that the configuration, texturing and coloring for exposed shotcrete be executed under the detailed direction of the Architect/Exhibit Designer, at least until such time as satisfactory examples of the desired character have been developed. Notify the Owner's Representative at least forty-eight hours before beginning placement of first example of each type of shotcrete to be exposed and schedule time when the Architect/Exhibit Designer can observe and direct the finishing work as it is executed.
The animal species utilizing these exhibits, including African bull elephants, rhinos, hippos, giraffe, zebra, antelope, ostrich, and more, are excellent jumpers and climbers. It is the Exhibit Subcontractor’s responsibility under the direction of the Zoo and Owner’s Representative to insure that the finished work is completed in a way to not pose an animal escape hazard, to the satisfaction of the Owner.

1.14 TESTING SERVICE

A. Owner will contract and pay for testing services. Exhibitry subcontractor shall cooperate and coordinate testing with Owner provided testing service.

1.15 GUARANTEE

A. Guarantee work in this section for one year from date of Final Acceptance.

B. Repair or replace materials if there is a failure to perform as required due to failures of materials or workmanship.

1.16 PRICES

A. Contractor will provide unit prices for all rockwork types listed on schedule to be used in change orders (if required).

B. Waste, Rebound and Extra Material Required for Realistic Natural Simulations: Past experience in similar zoo projects indicates that up to 35% extra concrete material (above what appears on the drawings) is or may be required to create realistic, natural simulations of the items to be provided. All bids should reflect this extra material and labor for application.

C. Bids shall include cost of all subsurface footings and other requirements needed to complete the work.

2. PRODUCTS

2.01 ARTIFICIAL ROCKWORK (SHOTCRETE) MATERIALS

A. Reinforcing Materials:
   1. Epoxy Coated Reinforcing Bars: use for all pool, beach, and rock areas immediately around pools, and within 5' of pool area, ASTM A 775/A 775M, Grade 60. Refer to part 3.06 of this specification section for minimum sizing and placement.
   2. Galvanized Reinforcing Bars: beyond areas noted in 2.01.A.1 including mudbank walls, rockwork outside of exhibits and dig zone. ASTM A 615, Grade 60. Refer to part 3.06 of this specification section for minimum sizing and placement.
   3. Metal Lath: Galvanized, unpainted metal lath, corresponding to ASTM F-1267, as follows:
      a. Type I - Expanded – ½”.
      b. Class 2 – Galvanized, Grade ‘A’ coating designation (00025 in. min. coating).
   4. Mesh Reinforcing: Galvanized, unpainted, welded steel wire fabric, corresponding to ASTM A185, and ASTM A-82, as follows:
      a. Size: 6 x 6 – W1.4 x W1.4
   5. Mesh Overlay: Galvanized, unpainted, welded steel wire fabric, corresponding to ASTM A185, and ASTM A-82, as follows:
      a. Overlay Size: 6 x 6 – W0.5 x W0.5
   6. Mesh Screening (Wire Cloth): Galvanized, unpainted, 2”x2”x14 ga. Square mesh, plain
weave.

7. **Pool Ground System**: for pool grounding system. 6x6 WWM. See Electrical Specifications.

8. For shotcrete surfaces, other than those applied over inclined or horizontal surfaces, backup material shall be “truss loop” as manufactured by Bostwick Steel Lath Company, Niles, Ohio, or approved equal.

9. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing supporting, and fastening reinforcing bars. Comply with requirements of Section 03200.

B. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I or II. Use only one brand of cement throughout the project, unless otherwise acceptable to Architect.

2. Aggregates: ASTM C 33, and as herein specified:
   a. Fine Aggregate, including cinder fine where applicable. Sand shall be sharp, clean river sand, free of extraneous materials.
   b. Coarse Aggregate: Clean, uncoated processed aggregate containing no clay, mud, loam or foreign matter, as follows: crushed stone, processed from natural rock or stone; washed gravel, either natural or crushed. Use of pit or bank-run gravel is not permitted. Coarse aggregate shall be maximum 5/8 inch diameter, and shall be used only where walls are unexposed, covered, or enclosed by a final shotcrete application or are building walls.

3. Water: Clean, fresh, free from oil, acid, organic matter or other deleterious substances.


5. Calcium Chloride: Do not use calcium chloride in concrete, except as otherwise authorized in writing by the Architect.

6. Waterproofing:
   a. **Pools**: Waterproofing shall be provided for all pool and rock surfaces underwater and to one foot above pool waterline. This waterproofing shall be integrated into the shotcrete and shall consist of the following 3 parts that, when combined, act as a shotcrete/waterproofing system:
      i. structural shotcrete coat with all structural reinforcing.
      ii. cementitious acrylic emulsion-based flexible waterproofing applied to the structural coat.
      iii. finish shotcrete coat applied to the cementitious acrylic emulsion-based waterproofing

1. Cementitious acrylic emulsion-based flexible waterproofing. Use one of the following:
   i. “Aquafin-2K/M” as manufactured by Concrete Moisture Solutions Inc. Aquafin, Inc., Columbia, MD 21044, 410.964.3165. Apply to structural coat to a thickness of 3/32” (90 mil). Apply as per manufacturer’s recommendations.
   ii. Approved equal.


8. Expansion Material - closed cell, pre-molded joint filler. "Etha Foam" or equal.

9. Moisture Retaining Cover:
   a. Burlap: Cloth made from jute and weighing approximately 9 oz. per sq. yd. for moist curing and conforming to AASHTO M 182.
   b. Membrane forming curing compound: ASTM C 309

C. Concrete Mix Design for Shotcrete:

1. **Mix Design**: Concrete for artificial rockwork shall have $f'c = 4500$ p.s.i. (minimum) at 28 days, 7.5 sacks of Portland Cement per cubic yard (=94 lbs.) of cement. Use air-entraining admixture. Add admixture at the manufacturer’s prescribed rate to result in concrete at the point of placement having 4½% - 7½% entrained air. Aggregate will be 60% sand, 40% gravel per yard.
2. Proportions: The proportions of cement to aggregate, in loose dry volumes, shall not be less than one to four and one-half.
3. Water-Cement Ratio: Use water-cement ratios between .35 and .45 (by volume) unless otherwise authorized in writing.
4. Waterproofing: Include in the mix design the cementitious based waterproofing specified above.
5. Water Content at Discharge: The water content at the time of discharge, including any moisture in the fine aggregate, shall not exceed three and one-half gallons per sack of cement.
6. Mixing: The cement, aggregate, and waterproofing shall be thoroughly mixed prior to the addition of water. At the time of mixing the fine aggregate shall contain not more than 3% moisture.

2.02 EXHIBIT ARTIFACT AND MISCELLANEOUS MATERIALS
A. Paint shall be acrylic latex, highest quality exterior grade, matte finish.
B. Eyebolts, access doors, and fasteners shall be galvanized steel (G-90) in the sizes shown on the drawings.

3. EXECUTION
3.01 GENERAL
A. Scope:
   1. Coordinate excavation and backfill with site grading contractor, allowing for use of earth face as backform where appropriate. Maintain earth grades and shapes once shotcrete work has commenced.
   2. Coordinate exhibit construction in a pre-scheduled manner to allow proper access and operation with other trades.
   3. Provide and apply waterproofing systems to pools, streams, and planters shown.
   4. Cooperate with Exhibit Designer and respond to directions for the purpose of achieving the artistic effects illustrated by the contract documents and reference photos.
   5. Coordinate and install exhibit elements required by this and other Sections required for a complete installation as detailed on the Drawings.
   6. Finish, color and detail shotcrete construction with skill and sensitivity for the exhibit purposes, the character of the simulated landscape and the care of the animals.
   7. Install eyebolts and access doors as shown on the plans.

3.02 TESTING REQUIREMENTS
A. Submit for acceptance proportioning and test data from prior experience if available. If data from prior experience are not available or are not accepted, make and have tested specimens from three or more different mix proportions in accordance with 3.08F Testing of this specification. Submit recommended mix proportions and test results for acceptance.

B. Shotcrete shall have a compressive strength as specified. Proportions shall be selected on the basis of compressive strength tests of specimens continuously moist cured until testing at 28 days. These specimens shall be cut from the shotcrete test panels not earlier than 5 days after shotcreting. For mix acceptance purposes, average core strengths shall be at least equal to 85% of f’c for cores with L/D of 2.0.

3.03 PLACEMENT OF EXHIBIT FEATURES
A. Layout: All items shall be placed at locations on the site and grades shown on the Drawings and as directed by the Exhibit Designer.
3.04 FORMING SHOTCRETE STRUCTURES

A. At structural pool slabs, side walls, and background concrete walls, where artificial rockwork is to be constructed, use the backup construction described below or provide the Architect/Exhibit Designer with an alternate construction system for approval.

1. Construct an armature of metal lath on the unexposed side of the shotcrete structure as the backup construction material behind the steel reinforcing bars to which the shotcrete is applied.

2. Metal lath shall be bent to conform approximately to the welded steel reinforcing frame and shall be held away from the nearest bars a minimum distance of 2" min. In order to facilitate the installation of metal lath the contractor may increase the thickness of the shotcrete to do away with matching exactly the steel reinforcing outline. However, all variances from the steel outline must be approved by the Exhibit Designer.

3. Metal lath shall be fastened to the reinforcing bars by means of tie wires or anchor spacers. Ties or spaces shall be spaced not more than 10 inches on center in all directions. Space lath away from reinforcing rods such that reinforcing rods will be in the center of the finished structure. There must be a 2 inch minimum thickness of concrete between reinforcing bars and lath.

4. In pool locations, install pool grounding system throughout pool and to 3’ beyond the water level for pool grounding system. Allow for connection to copper bonding conductor. See Electrical Specifications.

5. Install eyebolts at pools and dig zone per the plans. Install and secure eyebolts along the top of shotcrete planter walls at approximate 8’ centers and angle into planter so as not to be seen from visitor viewing areas. Review locations for approval with Owner’s Representative prior to shotcrete placement.

B. Wherever a flash coat is to be applied to a concrete surface, the concrete surface shall be roughened texture with minimum 2" thickness. Test cores shall be taken to verify.

C. The finish form, color and texture of the finish surface must meet with the approval and be completed to the satisfaction of the Exhibit Designer, which approval, when given, must be in writing. Contractor shall bear all costs of any and all work required to secure such approval.

3.05 PROVISIONS FOR OTHER TRADES

A. The Exhibitry Subcontractor shall be responsible for coordination of all other trades and Owner supplied items to fully complete the habitat setting.

B. Provide sleeved openings in concrete formwork to accommodate work of other trades including irrigation and waterfall utilities. Determine size and location of openings, drains, skimmers, cavities, and chases from trades providing such items. All non-sleeved piping shall be set by the appropriate contractor except that sleeves shall be provided by the appropriate contractor and installed by the Rockwork/Artifact contractor. Accurately place and securely support items built into forms.

C. Coordinate installation of all continuous waterstops where shotcrete pool construction adjoins work of other trades.

3.06 STEEL REINFORCEMENT

A. Reinforcing sizes: The Exhibitry Subcontractor shall develop reinforcement sizing and placement to facilitate his/her work. All structural calculations for reinforcement must be fully and clearly documented by a registered professional structural engineer, licensed in the State of Alabama. Payment for these services is the responsibility of the Exhibitry Subcontractor.

B. General:
1. Clean reinforcement of loose rust, mill scale, earth, ice, and other materials which reduce bond with concrete.
2. Accurately position, support and secure reinforcement against displacement by construction or concrete placement operation. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
3. Notify Owner’s Representative upon completion of reinforcing and prior to placing shotcrete.

C. Minimum Standards: The following minimal steel placement standards are supplemental to the steel reinforcement notes shown on the drawings.
1. No. 4 reinforcing bars shall be placed on ten inch (10") centers both ways as the minimum acceptable amount of bar reinforcing, and shall be continuous around corners. The spacing shall remain the same but the bar size will increase where, in the opinion of the Engineer, it is deemed necessary. A No. 4 bar acting as a key rod shall be placed at intersections of all plan surfaces.
2. Tack-weld or wire bars where they contact or cross each other. The bars must form a rigid framework. All bars are to lap a minimum of fifty (50) diameters at splices. Touch up bars at welds.
3. Reinforcing bars shall be placed and bent around circles and curves, openings, corners, and angles to conform with the drawings. Bends are to be permanently shaped, not sprung into place. Particular attention shall be made to follow the outline of the stratified rock formations to eliminate excess non-reinforced rockwork outcroppings.
4. The tie bars and tie anchors which are exposed to air and which do NOT come in contact with any backfill material shall be given a protective covering of asphalt coating of at least one heavy coat or Rustoleum, or equal.
5. Tie bars and tie anchors which come in contact with backfill material shall be encased with a coating of shotcrete. Steel shall be covered by a minimum of 1" of shotcrete.
6. Additional #4 bars shall be used diagonally across corners of all openings, and wherever shotcrete formations act as beams additional #5 bars shall be placed at points of maximum stress, i.e., one in top and one in bottom extending 12" into supports. Additional #4 bars shall be integrated into the steel framework if such steel is necessary to provide a stable structure.
7. The mesh shall be placed on steel reinforcing on side opposite the backup material and shall be securely wired to the reinforcing bars at not less than 20-inch intervals in both directions. Mesh shall lap at least two (2) inches at adjacent ends.
8. Place reinforcing for pools and slabs uniformly 1-1/2" to 2" from the bottom of shotcrete slabs.
9. Refer to Section 03300 for epoxy patching materials and requirement for epoxy coated reinforcing.

3.07 MIXING CONCRETE
A. Mix concrete to obtain the compressive strengths identified above.
B. Mix integral color into the concrete mix to the recommendations of the color manufacturer and requirements of mix design.

3.08 PLACING CONCRETE
A. All shotcrete shall be placed to a minimum thickness of 6" unless otherwise noted.
B. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed.
C. Maintain reinforcing in the proper position during concrete placement operations.
D. Rebound: All rebound or accumulated loose aggregate shall be removed from the surface to be covered prior to placing the initial or any succeeding layers of pneumatically placed concrete.
Rebound may be re-used if it conforms to the requirements for aggregate, but not in excess of 25% of the total aggregate in any batch.

E. Joints:
   1. Unfinished work shall not be allowed to stand for more than 30 minutes unless all abrupt edges are tapered to a thin edge. Before resuming work, this sloped portion shall be cleaned and a bonding agent applied.
   2. All construction joints in shotcrete rocks shall be tapered off to an edge. Before shooting the adjacent section the sloped portion shall be thoroughly cleaned and wetted with compressed air and water blast. No square joints will be permitted. All construction joint locations must be so positioned as to conform to the natural rock appearance as shown on the models.
   3. Construction joints in either pool walls or slabs will be squared-off with a 2" x 4" key and waterstop.
   4. Expansion joints in either pool walls or slabs will be squared-off with a 2" x 4" key, waterstop, pre-molded joint filler and caulked.

F. Testing: At least four (4) shotcrete cylinders for each 100 bags of cement used shall be made and cured. Two cylinders shall be tested in 7 days and to in 28 days. The 28-day cylinders shall develop at least 4500 p.s.i. Cylinders shall be made and tested by the Owners independent testing agency.

G. Damage: All pneumatically placed concrete which subsides after placement shall be removed.

3.09 FINISHES
A. The Exhibit Subcontractor shall provide experts to complete the desired finishing for all work to receive a natural appearance. Such finishing and coloring shall cover all surfaces exposed to public viewing and extend at least 12 inches beyond view or below final backfill or grading. Exhibit Designer to provide color samples as a point of beginning for painting work.

B. Carved Rockwork Formations: Artificially constructed geology and sedimentary geologic formations, as illustrated on the drawings and photographs.

3.10 CURING SHOTCRETE CONCRETE
A. Cover and cure shotcrete concrete as described in Section 03300, taking special care not to disturb special textures achieved for this work.

3.11 POOL TESTS and PLANTER TESTS
A. All pools and planters shall be filled to capacity prior to installing any finishes. Water must hold a stable level at predetermined static water level for 48 hours. If the test is positive, finishes may be applied if the test is negative, locate and repair the leak and retest until the test is positive.

3.12 INSTALLATION OF ARTIFACTS AND OTHER ITEMS
A. Install deadfall as shown on the plans.

3.13 PAINTING
A. Paint all exposed surfaces of shotcrete. Painting shall make exhibit artifacts look as natural as possible, using provided references photos. Exhibit Designer shall be final judge of acceptable quality of painting.

B. In order to blend in with surrounding artificial rockwork, additional items in and around shotcrete such as eye bolts, doors, miscellaneous hardware, concrete walls, segmental retaining wall, etc., are to receive matching paint finishes.
3.14 **CLEAN-UP**

A. Clean-up rebound from operations and dispose of as void fill, as structural fill more than 3'-0" below finish grade, or off-site on a daily basis.

B. Do not leave or bury loose pieces of reinforcing, sheet or expanded metal, tie wire, plastics or any other material not fully-embedded in concrete.

C. Clean overspray and rebound from adjacent work (including natural boulders) at the completion of each day's placing (or sooner if required). Leave all surfaces broom-clean and unstained at the completion of the work.

3.15 **FINAL COMPLETION**

A. Contractor shall repair and patch all punchlist items to the satisfaction of the Architect.

B. Contractor shall carefully inspect all construction areas to remove all debris, particularly stones, steel bars, and other materials, which could be uncovered by the Animals.

3.16 **INSTRUCTIONS ON OPERATIONS AND MAINTENANCE**

A. Schedule an on-site instructional seminar with all required Zoo personnel. Instruct for the operations, proper usage, and maintenance of all items installed.

3.17 **SCHEDULE OF IMAGES: REFER TO THE ROCKWORK IMAGE BOOK**

A. The Exhibit Images identifies images for the rockwork and rockwork type adjacencies in order to give the contractor the intent of the design. These should be used as a guide for the form, texturing and transition of rockwork types.

3.18 **FIELD QUALITY CONTROL**

A. Refer to Section 03200 for reinforcing special inspection and Section 03300 for placement special inspections.

**END OF SECTION**
SECTION 04820 - REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

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

1.2 SECTION INCLUDES

A. Concrete Block.
B. Mortar and Grout.
C. Reinforcement and Anchorage.
D. Accessories.

1.3 RELATED SECTIONS

A. Section 01400 – Quality Control: Testing and Inspections
B. Section 03300 - Cast-in-Place Concrete.
C. Section 05120 - Structural Steel: Bearing plates embedded in masonry.

1.4 REFERENCES

A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2005.
B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2005.
E. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units; 2006b.
G. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2006.


1.5 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units and fabricated wire reinforcement.

C. Product Data: Include mortar and grout design mix and indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations. Provide mix designs not less than 14 days prior to beginning masonry work.

D. Reports: Submit reports of masonry unit strength tests prior to starting work.

E. Reports: Submit reports on mortar indicating conformance of component mortar materials to requirements of ASTM C 270.

F. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C 476 and test and evaluation reports to requirements of ASTM C 1019.

G. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, and accessories.

H. Shop Drawings: Provide drawing showing location of all proposed block control joints.

I. Manufacturer's Instructions: Submit packaged dry mortar manufacturer's installation instructions.

J. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.6 QUALITY ASSURANCE


1.7 MOCK-UP

A. If plain block shapes are used for reinforced walls, construct a masonry wall mock-up as a grout demonstration panel sized 4 feet long by 4 feet high, which includes mortar and accessories, reinforcement, and grout, to demonstrate proper grouting can be achieved. Destructive testing of this panel may be necessary to demonstrate compliance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 this section or applicable building code, whichever is more stringent.
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 depths as indicated on the drawings for specific locations.
   2. Strength: Minimum unit strength as required by ACI 530.1 to achieve prism strengths shown on drawings.
   3. Shapes: Provide double end or open core shapes for reinforced masonry walls excluding lintel, cap, and sill block units.
      a. Plain shapes may be used in non-reinforced areas.
      b. Plain shapes may be substituted for the above subject to grout demonstration panel and additional grouting requirements of this section.
   4. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, and control joint edges.
   5. Load-Bearing Units: ASTM C 90, normal weight.
      a. Hollow block.
      b. Exposed faces: Manufacturer’s standard color and texture where indicated.

2.2 MORTAR AND GROUT MATERIALS

A. Materials Not Permitted: Masonry cement, anti-freeze, salts.

B. Packaged Dry Mortar: ASTM C 387, Type N, using gray color cement.

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

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

E. Mortar Aggregate: ASTM C 144.

F. Grout Aggregate: ASTM C 404.

G. Water: Clean and potable.

H. Accelerating Admixture: Nonchloride type for use in cold weather. Obtain Architect’s approval prior to use.

2.3 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 03300; 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.

C. Adjustable Multiple Wythe Joint Reinforcement: Truss type with adjustable ties or tabs spaced at 16 in on center ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
   1. Vertical adjustment: Not less than 2 inches.

D. Rigid Anchors for Intersecting Bearing Walls: 1-1/2” wide by 24” long by 1/4” thick with ends turned up 2”. Hot-dip galvanized, ASTM A153, Class B.

2.4 ACCESSORIES

A. Preformed Control Joints: Polyvinyl chloride material. Provide with corner and tee accessories, fused joints. Minimum Shore Durometer hardness of 80, 5/8” thick shear section with 5/16” thick
flanges, total width not less than 2-3/8".

B. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 MORTAR MIXES

A. Ready Mixed Mortar: ASTM C 1142, Type RM.

B. Mortar for Unit Masonry: ASTM C 270, using the Proportion Specification.
   1. Engineered masonry: Type S.
   2. Masonry below grade and in contact with earth: Type S.
   3. Exterior, loadbearing masonry: Type S.
   4. Interior, loadbearing masonry: Type S.
   5. Exterior, non-loadbearing facade: Type N.

2.6 MORTAR MIXING

A. Control and accurately maintain specified proportions of the mortar materials during the entire progress of the work.

B. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.

C. Maintain sand uniformly damp immediately before the mixing process.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

E. If water is lost by evaporation, re-temper only within two hours of mixing.

F. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.7 GROUT MIXES

A. Bond Beams, Lintels, and Grouted Cores: 2,000 psi strength at 28 days; 8-10 inches slump; provide premixed type according to ASTM C94/C94M, or mix according to ATM C476.
   1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.8 GROUT MIXING

A. Mix grout in accordance with ASTM C 94/C 94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of grout.

2.9 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01400.

B. Concrete Masonry: Test each type, class, and grade of concrete masonry unit in accordance with ASTM C 140 for conformance to requirements of this specification.
   1. Provide test for each different masonry unit width, face shell thickness, and concrete unit weight.
   2. Supplier production test results may be used if tests are not more than 90 days old and supplier furnishes a certification that the units meet the requirements of this section.

C. Mortar Mixes: Test mortars for consistency, compressive strength, and water retentivity in accordance with ASTM C 780 recommendations for preconstruction testing.
1. Preconstruction tests will be used to establish optimum mortar proportions and establish quality control values for construction testing. They are not required to meet the compressive strength requirements of ASTM C270.

D. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify that preconstruction testing has been completed.
B. Verify that field conditions are acceptable and are ready to receive masonry. Resolve out-of-tolerance conditions prior to starting work.
C. Verify that reinforcing dowels are positioned in accordance with the drawings.
D. Verify that related items provided under other sections are properly sized and located.
E. 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. Clean reinforcement of loose rust.
C. 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.

3.4 PLACING AND BONDING
A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints. Provide full mortar bed at footings, grouted cores, foundations, and slabs.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar as work progresses.
E. Interlock intersections and external corners.
F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
I. Build all chases and recesses as shown on the Drawings or required by all trades. Cut all
masonry units to fit neatly around conduit or piping, outlet boxes, etc. Set grilles and other equipment furnished by others as required in masonry.

J. Do not enclose mechanical, electrical or work specified in other sections until such work has been inspected and approved by the proper local code authority and by the Engineer if required.

K. Install loose lintels, anchors, bolts, dowels, grounds, angles, plates, grilles, or similar items required for anchorage of other work. Refer to Drawings for specific bearing conditions.

L. Discard all mortar that has begun to stiffen or is not used within 2-1/2 hours of initial mixing. Maintain workability of mortar within the 2-1/2 hour period by retempering or remixing.

3.5 REINFORCEMENT AND ANCHORAGE

A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.

B. Joint Reinforcement: Install horizontal joint reinforcement 16 inches on center.
   1. Place masonry joint reinforcement in first joint above bottom of wall.
   2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
   3. Place continuous joint reinforcement in first and second joint below top of walls.
   4. Lap joint reinforcement ends minimum 6 inches.
   5. Provide prefabricated corner or tee sections at intersecting walls.

C. Anchors: Reinforce intersections between interior and exterior walls with rigid wall anchors 16 inches on center.

D. Anchors: Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

E. Wall Ties: Install wall ties at locations indicated, spaced at not more than 16 inches on center horizontally and 16 inches on center vertically, unless otherwise indicated on drawings.

F. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
   1. Grouted Cores: Construct masonry walls to provide continuous vertical cores with a clear area not less than 3"x4" and sufficient to provide a minimum 8" long solid section.
   2. Plain Block at Grouted Core Locations: Place block to provide a continuous vertical section of grouted wall, minimum 8" and maximum 12" long.

G. Concrete Block Lintels and Bond Beams
   1. Provide reinforced concrete block lintels and bond beams as indicated on the Drawings or specified herein. Use reinforced concrete block lintels at all openings in concrete block walls, including openings for mechanical and electrical work not specifically indicated to have other types of lintels. Do not use concrete block bond beams with breakout webs as lintel beams at masonry wall openings.
   2. Support and tie reinforcing in place with a minimum clearance of 3/4" between reinforcing and block shells. Build in anchors and other accessories.

3.6 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.

B. If plain block are used at grouted wall locations, fill cores with grout to provide a vertically continuous section of solid masonry wall a minimum of 8" and a maximum of 12" long.

C. Low-Lift Grouting:
   1. Limit height of pours to 16 inches.
   2. Limit height of masonry to 16 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.

4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

D. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
4. If plain masonry unit shapes are used at grouted locations, limit pour heights to 4 feet.
5. Place grout for spanning elements in single, continuous pour.

3.7 COLD WEATHER CONSTRUCTION
A. These procedures apply when the ambient temperature falls below 40° F, or the temperature of masonry units is below 40° F.

B. Construction
1. Minimum masonry unit temperature of 20° F when laid in the wall. Remove visible ice on masonry units before the unit is laid in the masonry.
2. Heat mortar sand or mixing water to produce mortar temperatures between 40° F and 120° F at the time of mixing. Maintain mortar above freezing until installed.
3. When ambient temperatures are between 25° F and 20° F, use heat sources on both sides of the masonry under construction and install windbreaks when wind velocity exceeds 15 mph.
4. When ambient temperatures are below 20° F, provide an enclosure for the masonry under construction and use heat sources to maintain temperatures above 32° F within the enclosure.

C. Protection
1. When mean daily temperatures are between 40° F and 32° F protect completed masonry from rain or snow by covering with a weather resistive membrane for 24 hours after construction.
2. When mean daily temperatures are between 32° F, and 25° F completely cover completed masonry with a weather resistive membrane for 24 hours after construction.
3. When mean daily temperatures are between 25° F and 20° F, completely cover completed masonry with insulating blankets or equal protection for 24 hours after construction.
4. When mean daily temperatures are below 20° F, maintain masonry temperature above 32° F for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps, or by other acceptable methods.

3.8 HOT WEATHER CONSTRUCTION
A. Employ the requirements of this section when the ambient temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph.

B. Construction
1. Maintain the temperature of mortar and grout below 120°F.
2. Flush mixers, mortar transport containers and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
3. Maintain mortar consistency by retempering with cool water.
4. Use mortar within 2 hours of initial mixing.

C. Protection: Fog spray newly constructed masonry until damp at least three times a day until the masonry is three days old.

3.9 CONTROL JOINTS
A. Provide control joints as indicated on drawings, but not to exceed 24 feet on center.
B. Do not continue horizontal joint reinforcement through control joints.
C. Top of wall bond beam reinforcement extends through control joints.
D. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer’s instructions.
E. Keep expansion joint voids clear of mortar.

3.10 BUILT-IN WORK
A. As work progresses, install built-in anchor bolts and plates 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.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.11 TOLERANCES
A. Erection tolerances for masonry work shall be as specified in ACI 530.1.

3.12 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.

3.13 FIELD QUALITY CONTROL
A. Structural Testing and Special Inspection
   1. Structural Testing and Special Inspection shall be performed by qualified parties as specified herein, and in accordance with the provisions of Section 01410.
   2. For items indicated below to be performed on a periodic basis, provide inspections at least once per 250 square feet, and for 100% of all masonry beams and masonry columns.
   3. Personnel Qualifications
      a. Testing Technician: Technical I - NCMA Concrete Masonry Testing Technician (or equivalent), employed by a testing laboratory with C.C.R.L. certification at the National Bureau of Standards, under the direct supervision of a licensed civil/structural engineer. The licensed engineer shall review and approve all reports.
      b. Special Inspector - Structural I: ICBO certified masonry inspector, or a graduate civil/structural engineer or other personnel acceptable to the Structural Engineer of Record (SER) with experience in the design of structural systems of this type. Inspections shall be performed under the direct supervision of a licensed structural engineer, as defined in Section 01410. The licensed engineer shall review and approve all inspection reports.
   4. The Owner will provide the following tests:
      a. Concrete masonry unit compressive strength according to ASTM C140. One set of tests of each size block for the first 500 square feet installed and for each additional 5,000 square feet or portion thereof.
      b. Test mortar for consistency, water content, mortar aggregate ratio, air content (for air-entrained mortars), and compressive strength, according to ASTM C780. Conduct one test for each 2,500 square feet of wall area. Qualifications: Technical I.
      c. Test and evaluate grout according to ASTM C 1019 procedures. Test with same
d. Observe preparation of masonry wall prisms or selection of masonry units for strength tests and preparation of grout specimens and mortar specimens. Qualifications: Technical I.

e. At the beginning of masonry construction, observe proportions of site-prepared mortar, construction of mortar joints, and location of reinforcement and connectors. Qualifications: Structural I.

f. On a periodic basis, verify size and location of structural elements; type, size and location of anchors including anchors to structural members or other construction, grade, size, and type of reinforcing; welding of reinforcing bars; and hot and cold weather protection. Qualifications: Structural I.

g. On a periodic basis prior to grouting, verify that grout space is clean, placement of reinforcing and connectors, proportions of site-prepared grout, and construction of mortar joints. Qualifications: Structural I.

h. On a periodic basis, observe grout placement to verify compliance with code and construction documents. Qualifications: Structural I.

5. An independent testing agency will perform field quality control tests, as specified in Section 01400.

3.14 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. At completion clean all exposed masonry surfaces. Remove all excess mortar, mortar stains, efflorescence, etc., to provide a uniform appearance. Materials and methods of cleaning shall be as recommended by masonry material manufacturer. Cut out and repoint defective joints. Protect other work to prevent staining and damage.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.15 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners which are subject to damage by construction activities.

B. Adequately brace all work to prevent damage of any kind. Mask, barricade or similarly protect work as required from damage during building operations. Protect installed material as necessary to prevent staining or damage from the elements.

C. Provide temporary bracing of masonry during erection. Do not remove bracing until building structure provides permanent bracing.

D. During erection, keep all walls dry by covering the top with a strong, waterproof membrane at each shutdown and the end of each day. Cover partially completed walls at all times when work is not in progress. Extend cover a minimum of 2 feet down both sides, and securely hold in place.

END OF SECTION
SECTION 05120 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Structural steel.
   2. Grout.

B. Related Sections include the following:
   1. Division 01 Section "Quality Control Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame not defined as structural steel.

1.3 DEFINITIONS
A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

1.4 PERFORMANCE REQUIREMENTS
A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand LRFD loads indicated and comply with other information and restrictions indicated.
   2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

B. Construction: Type 2, simple framing
1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submittal:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.

   C. Shop Drawings: Show fabrication of structural-steel components.
      1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
      2. Include embedment drawings.
      3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
      4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

D. Welding certificates.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
   1. Structural steel including chemical and physical properties.
   2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   3. Shop primers.

F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

B. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
   6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1.7 DELIVERY, STORAGE, AND HANDLING
A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION
A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS
A. W-Shapes: ASTM A 992/A 992M
B. Channels, Angles S-Shapes: ASTM A 36/A 36M
C. Plate and Bar: ASTM A 36/A 36M
D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
   1. Weight Class: Standard
   2. Finish: Black, except where indicated to be galvanized
F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS
A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
   1. Finish: Plain
5. Finish: Plain

2.3 PRIMER
A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
B. Galvanizing Repair Paint: ASTM A 780.

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

2.5 FABRICATION

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning"
F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
2.6 \textbf{SHOP CONNECTIONS}

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

1. Joint Type: Snug tightened

B. \textbf{Weld Connections: } Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances.

2.7 \textbf{SHOP PRIMING}

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistant materials.
5. Galvanized surfaces.

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

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.8 \textbf{GALVANIZING}

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize lintels shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

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

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.”

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency’s option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.
3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings."


1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

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

1. Joint Type: Snug tightened

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
   1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

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

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 05120
SECTION 05310 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Roof deck.

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
   2. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Submittal:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.

E. Welding certificates.

F. Field quality-control test and inspection reports.

G. Research/Evaluation Reports: For steel deck.
1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."


1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Steel Deck:
      a. ASC Profiles, Inc.
      b. Consolidated Systems, Inc.
      c. Epic Metals Corporation.
      d. Nucor Corp.; Vulcraft Division.
      e. Roof Deck, Inc.
      f. United Steel Deck, Inc.
      g. Valley Joist; Division of EBSCO Industries, Inc.
      h. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard

2. Deck Profile: As indicated
3. Profile Depth: As indicated
4. Design Uncoated-Steel Thickness: As indicated
5. Span Condition: Triple span or more
6. Side Laps: Overlapped

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Galvanizing Repair Paint: ASTM A 780

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 18 inches (450 mm) apart, maximum
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (450 mm) and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum
D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal ships' ladders.
4. Miscellaneous steel trim.
5. Metal bollards.
6. Metal downspout boots.
7. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Division 3 Section "Cast-in-Place Concrete": Installing anchor bolts, steel pipe sleeves, inserts and other items cast into concrete.
2. Division 4 Section "Reinforced Unit Masonry Assemblies": Installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 5 Section "Structural Steel Framing."
4. Division 5 Section "Metal Stairs."
5. Division 5 Section "Metal Railings."

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

A. Product Data: For paint products and grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified professional engineer.
E. Welding certificates.
F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.4 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 PROJECT CONDITIONS
A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.6 COORDINATION
A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 METALS, GENERAL
A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS
A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316L.
C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.
D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS
A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless-steel fasteners for fastening stainless steel.
2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 9 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.


F. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS AND SHIPS' LADDERS

A. Basis of design product: O'Keefe's, San Francisco, CA, 888-653-3333, subject to compliance with requirements provide the named product or comparable approved product. See drawings for size and model.

B. Provide metal ladders and ships' ladders where indicated. Provide brackets and fittings for installation.

1. Fabricate ships' ladders, including railings from aluminum.
2. Tread forms to be serrated.
3. Comply with applicable railing requirements in Division 5 Section "Metal Railings."

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
C. Galvanize miscellaneous steel trim.

2.10 METAL BOLLARDS
   A. Fabricate metal bollards from Schedule 40 steel pipe.
   B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
   C. Galvanize bollards.

2.11 METAL DOWNSPOUT BOOTS
   A. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
      1. Outlet: To discharge into pipe.

2.12 LOOSE BEARING AND LEVELING PLATES
   A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
   B. Galvanize plates.

2.13 LOOSE STEEL LINTELS
   A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
   B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.
   C. Galvanize loose steel lintels located in exterior walls.

2.14 STEEL WELD PLATES AND ANGLES
   A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL
   A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.
   B. Finish metal fabrications after assembly.
   C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES
   A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.17 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull Satin Finish: No. 6.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION
SECTION 05506 - ELEPHANT & RHINO CAGING SYSTEMS

1. GENERAL

1.01 Work Included

A. Steel Elephant and Rhino Barriers, including: bollard, rigid and cable.

B. Elephant Drinkers.

C. D-Rings in elephant building

D. Solid mesh panel caging systems

E. Construction, testing, and installation of a complete, functioning and safe elephant and rhino caging systems, including bollard, rigid and cable systems and other accessories and attachments essential for a complete and proper installation.

F. Coordination of Work Required for Proper Operation of the Elephant and Rhino Transfer Door Assemblies, Elephant and Rhino Restraint Devices, keeper access gates and with all other building systems.

G. Misc. Shop Fabricated Galvanized Ferrous Metal Items Required for a Complete and Proper Installation.

1.02 Related Sections

A. Section 05120 – Structural Steel: Requirements for steel installed for work of this Section.

B. Section 05500 - Metal Fabrications: Misc. Metal required for installation.

C. Section 05507 – Elephant & Rhino Door & Gate Assemblies

D. Section 09900 - Painting and Finishing: Scheduled finishes for work of this section.

1.03 Qualified Metal Fabricators and Installers

A. Only Subcontractors whose experience and workmanship that have been reviewed by the Owner and Architect/Exhibit Designer for the Work of this Section. Qualifications for companies include a minimum of ten (10) years experience in metal work of this type including, but not limited to; structural steel work, exposed steel. Companies requesting consideration shall submit written and photographic proof of previously performed projects.

1.04 References

A. ASTM A36 - Structural Steel, Shapes, and Bars.

B. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.

C. ASTM A325 - High Strength Bolts for Structural Steel Joints.

D. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.
E. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

F. ASTM A501 - Hot-formed Welded and Seamless Carbon Steel Structural Tubing.

G. AWS D1.1 - Structural Welding Code.

H. FS TT-P-641 - Primer Coating, Zinc Dust-Zinc Oxide (for Galvanized Surfaces.)

I. FS TT-P-645 - Primer, Paint, Zinc Chromate, Alkyd Type.


1.05 Field Measurements

A. Prior to submission of shop drawings, the Caging Contractor shall verify that all field measurements are as indicated on Caging Drawings and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

1.06 Submittals

A. Shop Drawings:
   1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   2. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

B. Submit for review, sealed shop drawings, samples, manufacturer's literature, and other relevant materials necessary for proper evaluation by the Architect.

C. Prior to submission of shop drawings, the Contractor shall verify that all field measurements are as indicated on Caging Drawings and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

   1. Shop Drawings: Submit for review complete plans, elevations and details of the elephant and rhino caging systems. Indicate all required parts, mechanical components, connections, power requirements, line diagrams and a complete parts list for the entire system. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

1.07 Mock-Up

A. After final review of the shop drawings, complete, full size, working mock-ups of the following systems shall be fabricated and installed for testing and review.

   1. Elephant bollards
   2. Rhino bollards
   3. D-Rings: wall-mounted, bollard-mounted
   4. Cable barrier
   5. Rigid barrier
   6. Elephant Drinker

B. Mock-ups shall be installed in one of the locations shown on the drawings, either in an animal holding building or on site. Installation of mock-up shall be representative of all materials and methods required for the final construction.
C. Mock-up shall be tested and operated to the full satisfaction of the Owner and Architect. Schedule an actual field test at least four (4) weeks prior and notify the following individuals to be present:

1. Owner’s Representative.
3. Hydraulic Transfer Door Contractor and Hydraulic Engineer.
4. Installers.

D. Corrections: If after testing, further additions, adjustments, or other modifications are required, do not proceed with any further installation. Make all required changes as directed, at no cost to the Owner, and schedule another field test if required by the Owner and Architect. After mock-up has been fully tested and accepted, final fabrication and installation of the rest of the caging systems may proceed.

E. Accepted Mock-up: The final accepted mock-up shall serve as a detailed example of workmanship and operation, and may remain in place as part of the final Work.

1.08 Warranty

A. Submit the following written warranty:

1. The fabricator/installer shall provide the Owner with a written warranty, signed and notarized, guaranteeing the materials, workmanship, and operation of the cable barrier systems for a period of not less than one (1) year from the date of 'substantial completion'. This warranty shall be separate from any other materials or operations warranty that may or may not be supplied by any parts supplier or manufacturer. Any defective materials, inadequate operation, or general failure of the system or any portion thereof during the warranty period, shall be the sole responsibility of the fabricator/installer.

B. Replace any defective materials with new materials furnished by the fabricator/installer at no cost to the Owner if failure occurs during the warranty period.

C. Damage of cable barrier system due to animals shall be excluded from Contractor warranty.

2. PRODUCTS

2.01 Steel Components

A. Steel: All shapes, sections, etc., supplied for work of this section shall be fabricated to the requirements of Section 05120 – Structural Steel. All steel in buildings to be galvanized only. All exterior steel to be galvanized. Prime and paint where indicated on the drawings.

B. Fasteners, Bolts, Nuts, and Washers: ASTM A325; all bolts, machine screws and fasteners shall be either torx or hex socket round head and flat head as indicated on the drawings except where specifically noted otherwise.

D. Welding Materials: AWS D1.1; type required for materials being welded.

D. Exposed Mechanical Fastenings: Flush countersunk torx or hex socket machine screws and bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Anchor Bolts: Hilti countersunk flathead hex socket "kwik-Bolts" for installation in monolithic concrete in sizes indicated on the Drawings, unless specifically noted otherwise.
2.02 **Interior and Exterior Elephant & Rhino Barriers**

A. Elephant and rhino barriers include but is not limited to:

1. Bollard Systems
2. Mesh Panels
3. Cable Barrier Systems of various heights
4. Rigid Barrier Systems of various heights

2.03 **Other Systems Provided and Installed**

A. Elephant Drinkers: Install new drinkers in quantities and locations shown on drawings. Provide L-70. Provide protection at all water lines in animal areas.

B. Elephant D-Rings: Fabricate and install new d-rings in quantities and locations shown on drawings.

2.04 **Finishes**

A. Paint all surfaces called out on the drawings to the requirements of Section 09900.

3. **EXECUTION**

3.01 **Preparation**

A. Verify that field conditions are acceptable and are ready to receive work. Do not install until any unsatisfactory conditions are corrected. Beginning Work constitutes contractor's acceptance of conditions as satisfactory.

B. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.

C. Clean and strip primed steel items to bare metal where site welding is scheduled.

D. Make provision for erection loads with temporary bracing. Keep work in alignment.

E. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate trades.

3.02 **Coordination**

A. Coordinate all material requirements with other pertinent specification Sections relevant to the Work of this Section.

3.03 **Preparation of Steel Assemblies**

A. Verify dimensions on site prior to shop fabrication.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Fabricate items with joints tightly fitted and secured. Make exposed joints butt tight, flush, and hairline. All oversized holes required for fabrication shall be welded & plugged. No holes, cavities, or other voids, will be acceptable, unless specifically designed into the caging system.

D. Continuously seal joined members by continuous welds.
E. Fit and shop assemble in largest practical sections, for delivery to site.

F. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius of 1/8". Radius all corners to 1/4".

G. Do not prime surfaces in direct contact bond with concrete or where field welding is required. Prime paint items scheduled with one coat.

3.04 Installation

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Perform field welding in accordance with ASW D1.1.

C. After installation, touch-up field welds, scratched or damaged surfaces with specified touch-up primer.

D. Remove all sharp edges, burrs, corners and slivers, which, in the opinion of the Architect, could injure animals or caregivers.

3.05 Welding Requirements

A. All exposed welds shall be ground smooth and galvanized.

B. Remove all sharp edges, burrs, corners, and slivers, which in the opinion of the Architect and/or Owner could injure animals or keepers.

3.06 Painting

A. Surfaces indicated in the drawings to be painted should be shop primed. Field paint all indicated surfaces to the requirements of Section 09900.

3.07 Animal Management Requirements of Construction

A. The following work items shall be installed and/or performed as part of the Base Work of this Section, whether or not specifically detailed or noted on the Drawings:

1. Exposed threaded bolts/studs shall be cut back to a maximum 1/8-inch projection wherever they occur within animal spaces.

2. Spot-weld all exposed fasteners (bolt heads, nuts, etc.) within all animal areas or that are within reach of animals. Minimize welding to caging frames, transfer door frames, or other galvanized surfaces. All welds shall be wire brushed or ground smooth to remove all sharp edges, and cold galvanized.

3. Guard plates fabricated from 12 gauge steel shall be installed wherever exposed cables or chains (on the keeper side) occur within 12 inches from the face of any gap in the construction. These guard plates shall be welded to the construction and extend a minimum of 8 inches beyond the cables/chains in any direction.

4. Cover plates fabricated from 12 gauge steel shall be installed wherever exposed hydraulic tubing, hoses, cables, chains, plumbing lines, electric lines, etc., occurs within animal holding rooms and for a distance extending 9'-0" outside any animal holding area. Cover plates shall be field bolted with 3/8-inch dia. specified bolt types at max. 24 inches o.c.

5. In order to minimize vermin infestation, all gaps occurring in any adjoining construction shall be caulked and sealed tight with the specified epoxy sealant to the requirements of Section 07900.

END OF SECTION
1. **GENERAL**

1.01 **Work Includes**

   A. Design, engineering, construction, testing, and installation of complete, functioning, and safe animal transfer door and gate assemblies including interior and exterior hydraulic and manual transfer door and gate systems, including all pumps, cylinders, hoses and back-up system, door and gate hardware and other accessories and attachments essential for a complete and proper installation.

   B. Elephant Restraint Device (ERD) (Elephant Static Squeeze) including scale and all accessories.

   C. Refurbish and install one relocated wall of ERD/Static squeeze.

   D. Elephant Working Walls.

   E. Manual keeper access gates adjacent to areas containing elephants.

   F. Manual service gates adjacent to areas containing elephants.

   G. Coordination of Work required for a complete and proper installation and operation of the elephant and rhino door systems, with elephant and rhino caging systems and all other building systems.

1.02 **Related Sections**

   A. Section 01550 – Animal management requirements of construction

   B. Section 05120 – Structural Steel: Requirements for steel installed for work of this Section.

   C. Section 05506 – Elephant & Rhino Caging Systems

   D. Section 09900 - Painting and Finishing: Scheduled finishes for work of this section.

1.03 **Operation of Hydraulic Transfer Door System**

   A. Hydraulic Transfer Door System shall have the following operational features:

      1. In the event of a system-wide power failure, each hydraulic transfer door shall be operated by an electrical back-up system.

      2. Doors should operate with speed control and instantaneous stopping.

      3. Travel speed of each door shall be 1 foot/second minimum, 2 foot/second maximum.

1.04 **Qualified Fabricators and Installers**

   A. Only Subcontractors whose experience and workmanship that have been reviewed by the Owner and Architect/Exhibit Designer for the Work of this Section shall be deemed qualified fabricators and installers. Qualifications for companies include a minimum of ten (10) years experience in animal transfer and restraint systems of this type including, but not limited to; hydraulic design, structural steel work, pachyderm door and gate systems. Companies requesting consideration shall submit written and photographic proof of five (3) previously performed equivalent projects with letters of recommendation from the Owners of those projects.

   B. All Subcontractors shall provide a combination of photos, drawings and written descriptions of their door and gate assemblies and system components whether or not
they are similar to or vary from the design documents, and to further clarify the design documents. Submitted documentation will need to be reviewed and approved by the Architect/Exhibit Designer and Owner prior to bid acceptance. At a minimum, Architect and Owner request to see Fabricators’ Basis-of-Design documentation for the following to be used on this project:

1. Methods of mounting doors and gates to bollards, masonry walls or freestanding post systems
2. Overhead tracks, trucks and trolleys for overhead sliding gates
3. Insulated exterior sliding door systems
4. Solid door systems
5. All hinge systems (doors, gates, working wall panels, etc.)
6. All hydraulic and manual latching mechanisms (doors, gates, working wall panels, etc.)
7. All manual and hydraulic locking mechanisms (doors, gates, working wall panels, etc.)
8. Details for preventing animal transfer doors from being pushed out of plumb by animals when in the full open and closed positions (bottom tracks, side catches, etc).
9. Electronic scales with digital readouts
10. Hydraulic fluid
11. Hydraulic hoses and/or stainless steel lines
12. Letter signed by an authorized company representative certifying that the company is in the business of designing and fabricating these types of systems for animal containment and has a working knowledge of elephant and rhino behavior and their anticipated live loading on Contractor provided systems and components.

C. The Owner reserves the right to reject non-qualified subcontractors, based on qualification submittals and, at their option, review of past work and references.

D. Subject to Compliance with the requirements of these specifications, pre-qualified designers, fabricators and installers for elephant and rhino transfer door assemblies include:


1.05 Submittals

A. Drawings are issued for design-build purposes only, and are not for construction. Dimensions and material sizes shown represent general guidelines and design intent only. Contractor must have a working knowledge of elephant and rhino behavior and their anticipated live loading on Contractor provided systems and components. It is not the Owner or the architect’s intent to prescribe live and dead loading criteria for these systems. Instead, the Contractor shall base its design on proven and successfully installed systems similar to those proposed for this project. Loading requirements are entirely the responsibility of the Design-Build Contractor. Design-Build Contractor is responsible for assembling final fabrication drawings. See paragraph 1.04B above.

B. Submit for review, sealed shop drawings, samples, manufacturer's literature, and other relevant materials necessary for proper evaluation by the Architect.

C. Prior to submission of shop drawings, the Contractor shall verify that all field measurements are as indicated on Caging Drawings and Schedules, and notify the Architect in writing of any major discrepancies. No fabrication shall proceed until all inconsistencies are corrected.

D. Shop Drawings: Submit for review complete plans and details of the hydraulic and manual transfer door and gate systems, elephant static squeeze, working walls, manual service gates, and ERD. Indicate all required parts, mechanical and electrical components, hydraulic components, connections, power requirements, line diagrams, appropriate engineering
calculations, and a complete parts list for the entire system. Indicate profiles, sizes, connection
attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

1.06 Mock-Up

A. After final review of the shop drawings, a complete, full size-working mock-up of one gate for
each gate type listed below shall be fabricated and installed, including all hydraulic pumps,
motors, electrical and mechanical components for testing and review. Gate types include:
   1. Elephant hydraulic sliding door
   2. Rhino hydraulic sliding door
   3. Hoofstock hydraulic swing gate
   4. Manual keeper access gate
   5. Manual service gate
   6. Elephant working wall
   7. Lockable valve cabinet
   8. ERD (static squeeze)

B. Mock-up shall be tested and operated to the full satisfaction of the Owner and Architect.
   Schedule an actual field test at least two (2) weeks prior and notify the following individuals to
   be present:
   1. Owner's Representative.
   2. Hydraulic Engineer.
   3. Manufacturer's Representative for the primary hydraulics components.
   4. Installers.
   5. Architect

D. Corrections: If after testing, further additions, adjustments, or other modifications are required,
do not proceed with any further installation. Make all required changes as directed, at no cost
to the Owner, and schedule another field test if required by the Owner and Architect. After
mock-up has been fully tested and accepted, final fabrication and installation of the rest of the
transfer door system may proceed.

C. Accepted Mock-up: The final accepted mock-up shall serve as a detailed example of
workmanship and operation, and may remain in place as part of the final Work.

1.07 Operations and Maintenance Data

A. Submit two (2) copies of an 'Operations and Maintenance Manual' to the Owner in a
   permanently bound hard cover binder or book. Include a 'Table of Contents' and subdivide all
   major sections of the Manual with 'dividers'. The Manual shall contain, but is not limited to, the
   following information:
   1. Names, addresses, and phone numbers of all Contractors, Subcontractors, and other
      companies and persons involved in the design, fabrication, and installation of the hydraulic
      transfer door system.
   2. Complete parts list, including manufacturers and local suppliers names and phone
      numbers.
   3. Complete line diagrams of hydraulic, mechanical, and electrical systems.
   4. One (1) set of final shop drawings with all required review stamps, dates, and signatures,
      and professional Engineers seal.
   5. Instructions for cleaning and maintenance, including a recommended periodic schedule for
      the Owner to follow.

B. Provide any 'Special Tools', (one of each type), if required as part of the routine operation and
   maintenance of the system. 'Special Tools' are devices that are considered unique to the
   system and not normally part of the Zoo's maintenance department inventory.

1.08 Warranty

A. Submit the following written warranty:
1. The fabricator/installer shall provide the Owner with a written warranty, signed and notarized, guaranteeing the materials, workmanship, and operation of the door and gate assemblies for a period of not less than three (3) years from the date of 'substantial completion'. This warranty shall be separate from any other materials or operations warranty that may or may not be supplied by any parts supplier or manufacturer. Any defective materials, inadequate operation, or general failure of the system or any portion thereof during the warranty period, shall be the sole responsibility of the fabricator/installer.

B. Replace any defective materials with new materials furnished by the fabricator/installer at no cost to the Owner if failure occurs during the warranty period.

2. PRODUCTS

2.01 General

A. Steel: All shapes, sections, etc., supplied for work of this section shall be fabricated to the requirements of Section 05120 – Structural Steel. All steel in buildings to be galvanized only. All exterior steel to be galvanized. Prime and paint where indicated on the drawings.

B. Fasteners, Bolts, Nuts, and Washers: ASTM A325; all bolts, machine screws and fasteners shall be Flush countersunk either torx or hex socket round head and flat head.

C. Anchor Bolts: Hilti countersunk flathead hex socket "kwik-Bolts" for installation in monolithic concrete.

2.02 Mesh

A. Mesh called out on drawings for door and gate systems shall be 2” x 2” x1/4” crimp-locked woven mesh with galvanized finish.

B. Prime and paint where specified.

2.03 Door & Gate Hardware & Keying

A. General: All hardware components and designs for hinges, latches, locking mechanisms, etc of this section must be reviewed and approved by the Architect/Exhibit Designer and Owner prior to Bid acceptance. See paragraph 1.04B.

B. Hinges: Provide greasable hinges.

C. Locking: Provide drop pin locks or locking slide bolts to be approved by the Owner.

D. Remote Sensing: Provide mounting and protection for remote sensing switch/indicator provided by others.

E. Keying: Lock cylinders shall match zoo standards.

F. Ratcheted Stops at Manual Doors: Provide a system of ratcheted stops at 1'-0" on center in all manual slide doors to prevent animals from throwing doors.

2.04 Hydraulic System

A. Hydraulic control units:
   a. Tank, pump, motor, valves and accessories should be provided at all pump locations shown on the drawings.
   b. All control units shall be connected to backup power supply from the generator provided on-site.
   c. All control units shall have on/off controllability at the unit that requires a key for
operation. Lock cylinders shall match zoo standards.

B. Hydraulic Fluid: Non-toxic, agricultural grade oil approved by Owner.

C. Hydraulic lines and/or hoses:
   1. Shall be provided from the control units to the directional valves and from the valves to
doors and gates for each hydraulic door and gate called out on the drawings.
   2. Diagrammatic routing of lines and hoses have been shown in the drawings for
reference. Final locations shall be coordinated in the field.
   3. All hoses and lines inside holding stalls, habitats or yards and within animal reach, shall
be protected from animals with galvanized steel cover plates or run inside galvanized
steel tubes or pipes. Appropriate accessibility for maintenance and replacement shall be
accounted for by any protection system.
   4. Buried hoses and lines shall be installed in conduits for easy installation, maintenance
and replacement.

D. Directional Valves and Control Systems:
   1. Locations are identified on the drawings.
   2. All doors to have hydraulic lever operated valve with speed control and instantaneous
stopping.
   3. Master shut off for all hydraulic operations shall be organized by location. Location to be
coordinated with Owner.

E. Valve Cabinets:
   1. Each valve and lever control or groupings of valves/controls shall be located inside a
key operated, lockable valve cabinet.
   2. Lock cylinders shall match zoo standards.
   3. Cabinets shall be elephant & rhino resistant construction made from 14 gauge (for
grouping of 6 valves or less) or 3/16” (for more than 6 valves) galvanized steel, primed
and painted.
   4. Cabinets shall be sized to enclose all hydraulic and electrical connections and large
enough to facilitate easy maintenance access.

F. Cylinders: Cylinders are to be mounted in order to protect cylinder and hose from animals.

G. Locking Device: Hydraulic locking device that automatically locks the door when closed and
automatically opens when the 'DOOR OPEN' lever/button is pushed.

2.05 ERD - Elephant Restraint Device (Elephant Static Squeeze)

A. Shall be the approximate size shown on the drawings.

B. Shall have the following features:
   1. Manual sliding gates at each end with vertical swing bars.
   2. Electronic floor scale with digital readout.
   3. (4) removable access/inspection covers in floor.
   4. Adjustable support legs.
   5. Manually operated vertical swing bars in side panels.

C. One side of ERD to be refurbished relocated working wall:
   1. Steel to be stripped, primed and painted.
   2. Hardware to be replaced as required to match operation of new working wall.

2.06 Electrical Components

A. Required electrical, as part of the design and installation, will include, but is not limited to, all
wiring, switches, controls, disconnects, connections, conduit, etc., from the power supply.

B. Coordinate electrical remote control and sensing requirements for the central computer
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control center in the elephant building and by push button controls where indicated.

2.07 Welding Requirements

A. All exposed welds shall be ground smooth.

B. Remove all sharp edges, burrs, corners, and slivers, which in the opinion of the Architect and/or Owner, could injure animals or keepers.

2.08 Finishes

A. All steel to be galvanized. Surfaces indicated in the drawings to be painted should be shop primed. Field paint all indicated surfaces to the requirements of Section 09900.

3 EXECUTION

3.01 Installation

A. Fabricate all components and systems only after all shop drawing submittals and field mock-ups have been completely received and tested to the satisfaction of the Owner and Architect.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

C. Perform field welding in accordance with ASW D1.1.

D. After installation, touch-up field welds, scratched or damaged surfaces with specified touch-up primer.

D. Remove all sharp edges, burrs, corners and slivers, which in the opinion of the Architect, could injure animals or caregivers.

3.02 Animal Management Requirements of Construction

A. The following work items shall be installed and/or performed as part of the Base Work of this Section, whether or not specifically detailed or noted on the Drawings:

1. Exposed threaded bolts/studs shall be cut back to a maximum 1/8-inch projection wherever they occur within animal spaces.

2. Spot-weld all exposed fasteners (bolt heads, nuts, etc.) within all animal areas or that are within reach of animals. All welds shall be wire brushed or ground smooth to remove all sharp edges.

3. Cover plates fabricated from 12 gauge steel shall be installed wherever exposed hydraulic tubing, hoses, cables, chains, plumbing lines, electric lines, etc., occurs within animal holding rooms and for a distance extending 9'-0" outside any animal holding area. Cover plates shall be field bolted with 3/8-inch dia. specified bolt types at max. 24 inches o.c.

4. In order to minimize vermin infestation, all gaps occurring in any adjoining construction shall be caulked and sealed tight with the specified epoxy sealant to the requirements of Section 07900.

END OF SECTION
SECTION 05511 - METAL STAIRS

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes: Metal stair assemblies for exterior locations, including the following:

1. Industrial-type stairs with steel grating treads.
2. Steel railings attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.

1.2  PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.

1.3  SUBMITTALS

A. Product Data: For metal stairs.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified professional engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
1.4 QUALITY ASSURANCE

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

   1. Industrial-Type Stairs: Industrial class.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs that are similar to those indicated for this Project in material, design, and extent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Wire Rod for Grating Crossbars: ASTM A 510.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

2.3 FASTENERS
A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.


2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS
A. Stair Framing:

1. Fabricate stringers of steel channels.
   
   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.

3. Weld stringers to headers; weld framing members to stringers and headers.

4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

B. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with openings in gratings no more than 1/2 inch in least dimension.

2. Surface: Serrated.

3. Finish: Galvanized.

4. Fabricate grating treads with rolled-steel floor plate or cast abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.7 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.


B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

C. Form changes in direction of railings as detailed.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that will be exposed in finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 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 to building construction as required to comply with performance requirements and as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION
SECTION 05521 - METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Steel railings for applications other than metal stairs.

B. Related Sections:
   1. Division 5 Section "Metal Stairs": Metal railings specified as part of metal stairs.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
      b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Railing brackets.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
D. Qualification Data: For qualified professional engineer.

E. Welding certificates.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.6 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

   1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Provide Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.


D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as detailed.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. Provide chain with eye, snap hook, and staple across gaps formed by railing sections at locations indicated. Fabricate from same metal as railings.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Fill vent and drain holes that will be exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. Provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

3.4 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, unless otherwise indicated. Provide brackets with 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.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.5 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION
SECTION 06100 - ROUGH CARPENTRY

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with timbers.
3. Wood cants, blocking and nailers.
4. Wood sleepers.
5. Plywood backing panels.

B. Related Sections:

1. Division 6 Section "Sheathing."
2. Division 9 Section "Paints and Coatings": Finishing timber and field painting steel timber connectors.

1.2  DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

2. NLGA: National Lumber Grades Authority.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3  SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Shop Drawings: For timber. Show layout, dimensions of each member, and details of connections.

C. Samples: Not less than 5 inches wide by 24 inches long, showing the range of variation to be expected in appearance, including surface texture, of timber and glulam products. Apply a coat of penetrating sealer to Samples.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Engineered wood products.
5. Expansion anchors.
6. Metal framing anchors.

E. Research/Evaluation Reports: For timber connectors, from applicable model code organization.

1.4 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

B. Manufacturer Qualifications for Glued-Laminated Timber: Provide factory-glued structural units produced by an AITC- or APA-licensed firm.


1.5 PRODUCT HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Maximum Moisture Content: 19 percent.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species for applications indicated, unless otherwise indicated on Drawings:
   1. Joists and Beams: Hem-fir (north); NLGA.
   2. Studs: Spruce-pine-fir; NLGA.

2.4 TIMBER FRAMING

A. General: Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable.
   1. Factory mark each item of timber with grade stamp of grading agency.
   2. Apply grade stamps to surfaces that will not be exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.

B. Timber Species and Grade: Rough Sawn Western Red Cedar No. 1.

C. Moisture Content: Provide timber with 19 percent maximum moisture content at time of dressing or provide timber that is unseasoned at time of dressing but with 19 percent maximum moisture content at time of installation.

D. Dressing: Provide timber that is rough sawn (Rgh) unless otherwise indicated.

E. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

F. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

G. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB, or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Western woods; WCLIB or WWPA.
   7. Northern species; NLGA.
   8. Eastern softwoods; NeLMA.
C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 3 grade; SPIB.
2. Hem-fir or hem-fir (north), Standard or 3 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Standard or 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 3 Common grade; NeLMA.
5. Northern species, No. 3 Common grade; NLGA.
6. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 TIMBER CONNECTORS

A. General: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.

B. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A 307, Grade A; provide nuts complying with ASTM A 563; and, where indicated, provide flat washers.

C. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

2.8 FASTENERS

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

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Where rough carpentry is preservative-treated, provide fasteners of Type 304 or Type 316 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

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

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as
determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material for Interior Locations: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.9 METAL FRAMING ANCHORS

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

1. Alpine Engineered Products, Inc.
2. Cleveland Steel Specialty Co.
3. Harlen Metal Products, Inc.
4. KC Metals Products, Inc.
5. Simpson Strong-Tie Co., Inc.
7. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.


1. Use for interior locations where stainless steel is not indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations, for framing anchors in contact with preservative-treated lumber, and where indicated.

E. Anchors in locations exposed to public view: Provide Simpson Strong-Tie Architectural Series with black finish.

F. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

G. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch-minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

H. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

I. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

J. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

2.10 MISCELLANEOUS MATERIALS
A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for Gluing Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with Fastening Schedule referenced on Drawings.

J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD SLEEPER, BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-
bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction, unless otherwise indicated.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

3.4 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists with crown edge up. Face nail to ends of parallel rafters.

1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.

2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

END OF SECTION
SECTION 06160 - SHEATHING

PART 1  GENERAL

1.1  SUMMARY
   A.  Section Includes:
       1.  Wall sheathing.
       2.  Roof sheathing.
   B.  Related Sections:
       1.  Division 6 Section "Rough Carpentry": Plywood backing panels.

1.2  SUBMITTALS
   A.  Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   B.  Research/Evaluation Reports: For building wrap, showing compliance with building code in effect for Project.

1.3  PRODUCT HANDLING
   A.  Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2  PRODUCTS

2.1  WOOD PANEL PRODUCTS, GENERAL
   A.  Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
   B.  Oriented Strand Board: DOC PS 2.
   C.  Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
   D.  Factory mark panels to indicate compliance with applicable standard.

2.2  ROOF SHEATHING
   A.  Plywood Roof Sheathing: Exterior, Structural I sheathing.
      1.  Span Rating: Not less than 24/0.
      2.  Nominal Thickness: Not less than 1/2 inch.
   B.  Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.
      1.  Span Rating: Not less than 24/16.
      2.  Nominal Thickness: Not less than 1/2 inch.

2.3  FASTENERS
   A.  General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Fastening Schedule as indicated on Drawings.

D. Use common wire nails with wood framing, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.

   c. Space panels 1/8 inch apart at edges and ends.
SECTION 06175 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood roof trusses.
2. Wood girder trusses.
3. Wood truss bracing.
4. Metal truss accessories.

B. Related Sections include the following:

1. Division 06 Section "Sheathing" for roof sheathing and subflooring.
2. Division 02 Section "Termite Control" for site application of borate treatment to wood trusses.

C. Allowances: Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Division 01 Section "Allowances."

1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

B. TPI: Truss Plate Institute, Inc.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

2. NLGA: National Lumber Grades Authority.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.
1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.
2. Maximum Deflection Under Design Loads:

1.5 SUBMITTALS

A. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer. Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
5. Show splice details and bearing details.
6. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Submittal:

1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood used to produce metal-plate-connected wood trusses complies with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
   a. Include statement indicating costs for each certified wood product.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

D. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer’s responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Source Limitations for Connector Plates: Obtain metal connector plates from a single manufacturer.

D. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

E. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations of TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.8 COORDINATION

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Grade and Species: For truss chord and web members, provide dimension lumber of any species, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

C. Grade and Species: Provide visually graded dimension lumber for truss chord and web members, of not less than the following grade and any of the following species:

1. Grade for Chord Members: No. 1
2. Grade for Web Members: Construction, Stud, or No. 3
3. Species: Southern pine; SPIB.

D. Grade and Species: Provide dimension lumber of any species for truss chord and web members, graded as follows and of the following minimum design values for size of member required according to AF&PA's "National Design Specifications for Wood Construction" and its "Supplement":

1. Grading Method: Visual
2. Design Values: As indicated on Drawings.
3. Design Values: Modulus of elasticity of at least 1,300,000 psi (8970 MPa) and an extreme fiber stress in bending of at least 1200 psi (8.3 MPa)

E. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section Rough Carpentry.

2.2 METAL CONNECTOR PLATES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Alpine Engineered Products, Inc.
2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
3. CompuTrus, Inc.
4. Eagle Metal Products.
5. Jager Building Systems, Inc.
6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
7. Robbins Engineering, Inc.
8. TEE-LOK Corporation; a subsidiary of Berkshire Hathaway Inc.

C. General: Fabricate connector plates to comply with TPI 1.
D. Hot-Dip Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for interior locations where stainless steel is not indicated.

E. Stainless-Steel Sheet: ASTM A 666, Type 304, and not less than 0.035 inch (0.88 mm) thick.

1. Use for exterior locations and where indicated.

2.3 FASTENERS

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

1. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.


2.4 METAL TRUSS ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

C. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:
1. Cleveland Steel Specialty Co.
2. Harlen Metal Products, Inc.
3. KC Metals Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Southeastern Metals Manufacturing Co., Inc.
6. USP Structural Connectors.

D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

   1. Use for interior locations where stainless steel is not indicated.

F. Stainless-Steel Sheet: ASTM A 666, Type 304
   1. Use for exterior locations and where indicated.

G. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to one side of truss, top plates, and side of stud below.

H. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches (38 mm) wide by 1 inch (25 mm) deep by 0.040 inch (1.0 mm) thick, made to fit between 2 adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.6 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
   1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses 24 inches (610 mm); adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in truss accessories according to manufacturer’s fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Division 06 Section Rough Carpentry.
2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not cut or remove truss members.

L. Replace wood trusses that are damaged or do not meet requirements.

1. Do not alter trusses in field.

3.2 REPAIRS AND PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.

1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 06175
SECTION 06200 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior wood trim.
   2. Log decorative trim.
   3. Exterior plywood soffits.
   4. Interior wood trim.
   5. Decorative mat.

B. Related Sections:
   1. Division 6 Section "Rough Carpentry": Furring, blocking, and other carpentry work not exposed to view.
   2. Division 9 Section "Paints and Coatings": Priming, backpriming, staining, and field finishing of finish carpentry.

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO Plywood: Plywood with a medium-density overlay on the face.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Include construction details, material descriptions, dimensions of individual components and profiles, textures, and colors.

B. Samples for Verification:
   1. Lumber: 50 sq. in. for each species and cut of lumber, with 1/2 of exposed surface finished.
   2. Log Siding: 12-inch long sample, full-size, of profile and texture indicated.

1.4 PRODUCT HANDLING

A. Protect materials against weather and contact with damp or wet surfaces. Stack lumber and panel products. Provide for air circulation within and around stacks and under temporary coverings.

B. Deliver interior finish carpentry only when environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit work to be performed according to manufacturer's written instructions and warranty requirements and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by the American Lumber Standards' Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. MDF: ANSI A208.2, Grade 130.

2.2 EXTERIOR TRIM

A. Lumber Trim for Semitransparent-Stained Applications: Kiln-dried lumber with surfaced (smooth) face graded to meet NLGA and WCLIB “grading standards” and of the following species and grade:

1. Western Red Cedar: Grade A clear and better with 30% of B clear allowed.

B. Lumber Trim for Painted Applications: Kiln-dried, solid lumber with surfaced (smooth) face and one of the following species and grade:

1. Hem-fir: NLGA, WCLIB, or WWPA; Grade 1 Common.
2. Eastern White Pine, Eastern Hemlock-balsam fir-tamarack, Eastern Spruce, or White Woods: NELMA, NLGA, WCLIB, or WWPA; Grade Finish or 1 Common (Colonial).
3. Northern White Cedar: NELMA or NLGA; Grade 1 Common.

2.3 LOG DECORATIVE TRIM

A. Logs for decorative trim at pre-engineered metal structure with stain and seal. Kiln dried.

1. Species: Lodgepole; Ponderosa pine or equal as approved by architect.
2. Logs to be hand scraped.

2.4 EXTERIOR SOFFITS

A. Plywood Soffits: Exterior-type, Grade B-C or stain grade as indicated.

1. Thickness: As indicated.
2. Face Grade: 303-OL.
3. Face Species: Southern pine or Douglas fir.
5. Surface: Smooth.

2.5 EXTERIOR DECORATIVE BAMBOO MAT

A. Herringbone Bamboo Plywood by Safari Thatch, Fort Lauderdale, FL 954-564-7021 with field applied polyurethane coating.

2.6 INTERIOR WOOD TRIM
A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish): Kiln-dried finished lumber (S4S) of one of the following species and grades:

1. Eastern White Pine: NELMA or NLGA; Grade D Select.
2. Idaho White, Lodgepole, Ponderosa, or Sugar Pine: NLGA or WWPA; Grade D Select (Quality).

B. Lumber Trim for Opaque Finish (Painted): Finished lumber (S4S), either finger-jointed or solid lumber, of one of the following species and grades:

1. Eastern White Pine: NELMA or NLGA; Grade Finish or 1 Common.
2. Idaho White, Lodgepole, Ponderosa, or Sugar Pine: NLGA or WWPA; Grade 1 Common (Colonial).
3. Douglas Fir-larch or Douglas Fir South: NLGA, WCLIB, or WWPA; Grade Prime or D finish.
4. Spruce-pine-fir: NELMA, NLGA, WCLIB, or WWPA; Grade 1 Common.
5. Alder, Aspen, Basswood, Cottonwood, Gum, Magnolia, Soft Maple, Sycamore, Tupelo, or Yellow Poplar: NHLA; Grade B Finish.
6. Yellow Poplar: NHLA; Grade B Finish.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws of the following materials, in sufficient length to penetrate minimum of 1-1/2 inches into substrate, unless otherwise recommended by manufacturer:

1. Stainless steel.
2. Hot-dip galvanized steel.

B. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

1. Where finish carpentry materials are exposed in areas of high humidity, provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A 153/A 153M.

C. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

E. Round Soffit Vents: Stamped aluminum louvered vents with insect screening, 3 inches in diameter, made to be inserted into round holes cut into soffit.

1. Insect Screening for Soffit Vents: Stainless steel, 18-by-18 mesh.
2. Finish: Paint to match soffit.

F. Sealants: Comply with requirements in Division 7 Section "Joint Sealants" for materials required for sealing siding work.

2.5 FABRICATION

A. Wood Moisture Content: Comply with requirements of specified inspection agencies and with manufacturer's written recommendations for moisture content of finish carpentry at relative humidity conditions existing during time of fabrication and in installation areas.
B. Back out or kerf backs of trim members, except members with ends exposed in finished work.

C. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours, unless longer conditioning is recommended by manufacturer.

C. Prime lumber for exterior applications to be painted, including both faces and edges. Cut to required lengths and prime ends. Comply with requirements in Division 9 Section "Paints and Coatings."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.

3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

4. Coordinate finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate finish carpentry.

3.4 WOOD TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

1. Match color and grain pattern across joints.

2. Install trim after gypsum board joint finishing operations are completed.

3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.
4. Fit exterior joints to exclude water. Apply flat grain lumber with bark side exposed to weather.

3.5 ADJUSTING

A. Replace finish carpentry that is damaged or does not comply with requirements. Finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

B. Clean finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION
SECTION 06610 - GLASS FIBER AND RESIN FABRICATIONS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Glass fiber reinforced, resin fabrications, including, but not limited to the following:
   1. FRP grates and treads.
   2. FRP Frames
   3. FRP Ladders
   4. Hardware and attachments.

B. Refer to scheduled list of items at end of section.

1.2  RELATED SECTIONS

A. Section 03300 - Cast-in-place Concrete: FRP items cast into concrete work where required.

B. Section 05500 - Metal Fabrications: Steel supports for FRP items.

1.3  REFERENCES


1.4  QUALITY ASSURANCE

A. Shop Fabricator: Company specializing in architectural glass fiber and resin components with five years documented experience.

1.5  REGULATORY REQUIREMENTS

A. Conform to applicable codes and regulations for flame/fuel/smoke requirements.

1.6  SUBMITTALS

A. Submit shop drawings, product data, test date, samples, and installation instructions under provisions of Section 01300.

B. Shop Drawings: Submit shop drawings indicating design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of plumbing components, and anchorages.

C. Product Data: Provide product data on specified component products.

D. Test Date: Provide test reports indicating U.S.D.A. approval and specified flame spread rating.

E. Samples: Submit two samples 6x6 inch minimum in size illustrating color, texture, and finish.

F. Installation Instructions: Submit fabricator's installation instructions on specified component products.

G. Maintenance Data: Include instructions for stain removal, surface and gloss restoration.

1.7  DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store, and handle products to site under provisions of Section 01600.

B. Protect components from damage by retaining shipping protection in place until installation.

1.8  STRUCTURAL REQUIREMENTS

A. Minimum Load Requirements: As shown on plan. Floor and stair landings shall be capable of supporting 300 lbs at the center of any span.

B. Maximum Deflection Requirements: Maximum deflection shall be limited to 1/360 of the span, not to exceed 0.25".
PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Provide the scheduled plastic fabrications, trim, and all accessories and attachments required for a complete and proper installation. Acceptable Fabricators are as follows:
      1. Fibergrate
      2. Enduro
      3. IKG Industries
      4. Chemgrate
      5. Strongwell
   B. FRP Ladders: Dynarail Ladder by Fibergrate, as indicated on drawings.

2.2 MATERIALS
   B. Roving: Continuous strand reinforcement for filament winding, impregnation, single end, wound into tubeless packaging, for polyester resin.
   C. Resin: Fungal resistant, Polyester type, fire resistant with a tested flame spread rating of 30 or less, high workability characteristics, integral coloring additives.
   D. Polishing Cream: Compatible gel coat polishing cream to restore gloss surface finish.
   E. Hardware for attachments: Stainless steel.

2.3 SHOP FABRICATION
   A. Finish trim corners and edges.
   B. Coat exposed surfaces and surfaces in contact with moisture or earth with gel coat of resin.
   C. Cure components prior to shipment and remove material that may be toxic to plant or animal life and incompatible with adjacent building materials.
   D. Sand and ease all edges to remove sharp corners.
   E. Non-slip Surfaces: Provide non-slip surfaces where scheduled using a molded in, grit-top surface. Concave non-slip surfacing is not acceptable.

2.4 FINISH
   A. Color: Color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
   B. Beginning of installation means acceptance of existing surfaces.

3.2 INSTALLATION
   A. Install fabrications in accordance with shop drawings and fabricator's instructions.
   B. Do not exceed the span ratings for each of the items specified.

3.3 TOLERANCES
   A. Maximum variation from true position: 1/4 inch.
   B. Maximum offset from true alignment: 1/8 inch.

3.4 CLEANING
A. Clean components of foreign material without damaging finished surface.
B. Clean fabrications in accordance with fabricator's instructions.

3.5 PROTECTION OF FINISHED WORK
   A. Protect finished installation under provisions of the General Conditions.

3.6 SCHEDULES
   A. Interior Trench Grates: 1" high / 1-1/2" x 1-1/2" mesh smooth surface.
   B. Exterior LSS Pit Covers: 1-1/2" high / 1-1/2" x 1-1/2" mesh non-slip surface.

END OF SECTION
SECTION 06640 - FRP PANELING AND CEILING GRID

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories, ceiling grid system and ceiling panels.

B. Related Sections:
   1. Division 9 – “Non-Load Bearing Steel Framing”
   2. Division 9 – “Gypsum Board”
   3. Division 9 – “Acoustic Panel Ceilings”
   4. Division 9 – “Resilient Synthetic Flooring”

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For plastic paneling, trim accessories, and ceiling grid.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 200 or less.
   2. Smoke-Developed Index: 450 or less.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Glasbord wall and precut ceiling tiles by Crane Composites (Kemlite), Channahon, IL, 800-435-0080 or comparable approved product.
   2. Nominal Thickness: Not less than 0.09 inch at wall tiles, 0.10 inch at ceiling tiles.
   3. Size: As indicated on drawings.
   4. Surface Finish: Molded pebble texture
   5. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
1. Color: Match panels

B. Adhesive: As recommended by plastic paneling manufacturer.

1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Sealant: Latex sealant recommended by plastic paneling manufacturer and complying with requirements in Division 7 Section "Joint Sealants."

1. VOC Content: 250 Insert limit g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 CEILING GRID

A. Manufacturer's standard fiberglass grid system

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sanigrid II by Crane Composites (Kemlite), Channahon, IL, 800-435-0080 or comparable approved product.

2. Size: As indicated on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches

3.2 INSTALLATION

A. Install plastic paneling, accessories, and ceiling grid according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

E. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION
SECTION 07115 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Bituminous dampproofing applied to the following surfaces:
   1. Exterior, below-grade surfaces of foundation walls without building space on opposite side.
   2. Back side of concrete and masonry retaining walls, below grade.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.4 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 PRODUCTS

2.1 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ChemMasters Corp.
   2. Degussa Building Systems; Sonneborn Brand Products.
   3. Henry Company.
   5. Koppers Inc.

B. Trowel Coats: ASTM D 4586, Type I, Class 1, fibered.

C. Brush and Spray Coats: ASTM D 4479, Type I, fibered or nonfibered.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ChemMasters Corp.
   2. Degussa Building Systems; Sonneborn Brand Products.
   3. Henry Company.
5. Koppers Inc.

B. Trowel Coats: ASTM D 1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS


B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

D. Patching Compound: Epoxy or latex-modified repair mortar or manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.

2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats, unless another period is recommended by manufacturer.

3. Allow 48 hours drying time prior to backfilling, unless another period is recommended by manufacturer.

B. Apply dampproofing to footings and foundation walls where opposite side of wall does not face building interior.
1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.25 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, or 1 trowel coat at not less than 4 gal./100 sq. ft.
B. On Masonry Foundation Walls: Apply primer and 2 brush or spray coats at not less than 1.25 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, or primer and 1 trowel coat at not less than 4 gal./100 sq. ft.
C. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft.
D. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray coat at not less than 1.25 gal./100 sq. ft.

3.5 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Masonry Backup for Simulated Stone Veneer: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft.

3.6 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION
SECTION 07161 - MODIFIED CEMENT WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Polymer-modified cement waterproofing for the following applications:
   1. Tanks in filtration building.

B. Related Sections:
   1. Division 3 Section "Cast-in-Place Concrete": Finishing concrete walls and slabs to receive waterproofing.
   2. Division 3 Section "Exhibit Rockwork and Artifacts": Cementitious waterproofing at pools.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions and installation instructions for polymer-modified cement waterproofing.

B. Samples for Initial Selection: For each type of polymer-modified cement waterproofing indicated.
   1. Include Samples of available color selection.

C. Samples for Verification: For each type of polymer-modified cement waterproofing indicated.

D. Qualification Data: For Applicator.

E. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of polymer-modified cement waterproofing.

G. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

B. Mockups: Provide mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical vertical and horizontal surfaces of animal pool, approximately 10 sq. ft. in size.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.4 PROJECT CONDITIONS
A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit polymer-modified cement waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 PRODUCTS

2.1 PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

A. Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with polymer admixture to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists positive-side hydrostatic pressure, has VOC content complying with limits of authorities having jurisdiction, and has properties meeting or exceeding the criteria specified below.

1. Basis-of-Design Product: Subject to compliance with requirements, provide AQUAFIN, Inc.; AQUAFIN-2K/M.
2. Water Permeability: Withstands 200 psi = 460 feet when tested according to CE CRD-C 48.
3. Compressive Strength: Minimum 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
4. Flexural Strength: Minimum 710 psi at 28 days when tested according to ASTM C 348.
5. Bond Strength: Minimum 215 psi at 28 days when tested according to ASTM C 321.
6. Color: As selected by Architect from full range.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

1. Basis-of-Design Product: AQUAFIN, Inc.; MORTAR-LN.

B. Sealing Tape: Manufacturer's recommended elastomeric product for sealing joints and cracks.

1. Basis-of-Design Product: AQUAFIN, Inc.; AQUAFIN JOINT SEALING TAPE.

C. Reinforcing Mesh: Polypropylene non-woven fleece, as recommended by waterproofing manufacturer for treating zones subject to cracking.


D. Sealing Gasket: Elastomeric gasket as recommended by waterproofing manufacturer for sealing PVC pipe and other penetrations.


E. Decorative Protective Coating: One-component, solvent-free, ready-to-use acrylic liquid recommended by waterproofing manufacturer as topcoating over waterproofing to produce a smooth, decorative finish.

F. Portland Cement: ASTM C 150, Type I.
G. Slurry-Coat Sand: ASTM C 144.
H. Trowel-Coat Sand: ASTM C 33, fine aggregate.
I. Water: Potable.

2.3 MIXES

A. Prepackaged, Polymer-Modified Cement Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
B. Proceed with application only after unsatisfactory conditions have been corrected.
C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.
B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
   1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately 1 inch deep. Fill reveal with patching compound flush with surface.
E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
   1. Clean concrete surfaces according to ASTM D 4258.
      a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
      b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
2. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions. Tape horizontal and vertical construction joints with sealing tape embedded in waterproofing materials, using procedures according to manufacturer's written instructions.

3. Seal around PVC pipe and similar penetrations by fitting sealing gasket over pipe and embedding in waterproofing material according to manufacturer's written instructions.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water and maintain damp condition until applying waterproofing. Remove standing water.

2. Apply waterproofing to surfaces indicated on Drawings.

3. Number of Coats: Number required for specified water permeability, but not less than two.

   a. Coating Thickness: Maximum application thickness of 47 mils per coat for total thickness of 100 mils, unless otherwise required for specified water permeability.

   b. Apply first coat as a slurry with brush or roller, and apply subsequent coats with brush, roller, spray, or trowel.

   c. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.

   d. Allow manufacturer's recommended time between coats. Dampen surface between coats.

B. Final Coat Finish: As follows for applications indicated:

1. Filtration Tanks: Smooth troweled.

C. Curing: Air-cure waterproofing for not less than five days immediately after application and prior to being placed in service.

3.4 FIELD QUALITY CONTROL

A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.

END OF SECTION
SECTION 07210 - BUILDING INSULATION

PART 1   GENERAL

1.1  SUMMARY

A. Section Includes:

1. Insulation under radiant floors.
2. Concealed building insulation.

B. Related Sections:

1. Division 3 Section “Cast-in-Place Concrete”
2. Division 7 Section "Adhered Thermoplastic Membrane Roofing": Insulation specified as part of roofing construction.

1.2  DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.3  SUBMITTALS

A. Product Data: For each type of product indicated.

1.4  QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.


C. FM Approvals Listing: Provide insulation materials complying with one of the following:

1. FM-Approved Class I or non-combustible.
2. Non-plastic materials with Flame Spread 25 or less when tested according to ASTM E 84.

1.5  PRODUCT HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION
   A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 5 and 175, respectively:
      1. Radiant Floors: 400-psi minimum compressive strength.
         a. Basis-of-Design Product: Subject to compliance with requirements, provide Owens Corning Foamular 400, 2” high compressive strength rigid insulation, or comparable product of another approved manufacturer.

2.2 GLASS-FIBER BLANKET INSULATION
   A. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft vapor-retarder membrane on 1 face.

2.3 AUXILIARY INSULATING MATERIALS
   A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.
   B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
   C. Strapping: Provide strapping at min. 2'-0”o.c. to prevent sagging of glass fiber blanket insulation.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
      1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL
   A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
   B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

C. Where coarse backfill materials is used that might damage insulation, protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

D. Where slab installation is likely to damage insulation, protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

C. Install blanket insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

4. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:
a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

D. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces unless otherwise indicated. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.6 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 07312 - PVC THATCH SHINGLE ROOFING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. This Section Includes the following:
   1. PVC thatch shingles.
   2. Self-adhering sheet underlayment.

B. Related Sections include the following:
   1. Section 07620 - METAL FLASHING AND TRIM for metal counter flashings not part of this section.
   2. DIVISION 13 – PRE-ENGINEERED BUILDINGS for tongue and groove wood deck.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For the following products, of sizes indicated, to verify color selected.
   1. PVC Thatch Shingle: Full-size thatch shingle strip.
   2. Self-Adhering Underlayment: 12 inches square.

C. Qualification Data: For Installer, including certificate signed by PVC thatch shingle manufacturer stating that installer is approved, authorized, or licensed to install roofing system indicated.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for PVC thatch shingles.

E. Maintenance Data: For PVC thatch shingles to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide installed PVC thatch shingles, self adhering membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Fire-Test-Response Characteristics: Provide PVC thatch shingle and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A, ASTM E 108 or UL 790, for application and roof slopes indicated.

C. Wind Uplift Design: Provide roofing system that complies with the following:
   1. Roofing System Manufacturer's written design instructions.
   2. 1997 UBC Chapter 16 Division III require wind forces:
      a. Exposure Category: Exposure D
      b. Basic Wind Speed: 80mph
      c. Importance Factor: 1.0

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that has 5 years experience in manufacturing the PVC thatch shingle system identical to that specified for this Project.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated, weather tight location according to PVC thatch shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double-stack rolls.

1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace PVC thatch shingles that fail in materials or workmanship in accordance with unconditional warranty terms for period noted below. Material failures include manufacturing defects, rot/decay, delamination, or UV degradation.

1. Manufacturer's Unconditional Warranty Period: 10 years

B. Roofing Installers Warranty: shall warrant installation against leaks and faulty or defective materials and workmanship for designated Warranty Period.

1. Warranty Period: 5 years

PART 2 PRODUCTS
2.1 APPROVED SUPPLIERS AND INSTALLERS

A. Approved Suppliers and Installers:

1. Endureed Premium Thatch, Global Innovation LLC, Lake City, FL 32025, (577) 784-2824
2. Safari Thatch, Fort Lauderdale, FL 33308, (954) 564-0059

2.2 MATERIALS

A. PVC Thatch Shingle: Simulated reeds manufactured from PVC bound by a metal binder strip made of grade 304 stainless steel or reinforced polyurethane binder strip.

1. Reed Style:
   a. Cape Town by Endureed
   b. Fibre Thatch by Safari Thatch
2. Shingle Dimensions: 10-inches long by 36-inches wide
3. Average Exposure Length: 5 inches


1. Product: Colphene® HR FR GR (76) manufactured by Soprema or equal.
   a. Color: by Architect
2. Provide complete weathertight roof assembly.
3. Provide manufacturers standard roofing warranty.

2.3 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; 11 gauge stainless-steel, annular ring shank, sharp-pointed, with a minimum 11/32-inch diameter flat head and of sufficient length to penetrate ¾ inch into solid wood decking or extend at least 1/8 inch through plywood sheathing.

2.4 METAL FLASHING AND TRIM

A. Sheet Metal Flashing and Trim: Comply with requirements in Section 07600 SHEET METAL FLASHING.


PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and self-adhering membrane.
3. Submit written report, to the Contractor signed by Installer, listing conditions detrimental to performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below and on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches Lap ends not less than 6 inches staggered 24 inches between courses.

1. Hips: Extend bottom corner 3 inches on each side.

3.3 FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07600-SHEET METAL FLASHING.

B. Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing.

3.4 PVC THATCH SHINGLE INSTALLATION

A. Install PVC Thatch Shingles according to manufacturer’s written instructions. “Look and Feel” shall be as shown in the photograph at the end of this section. Should simulate a custom thatch roof with no discernible horizontal shingle lines.

B. First Course: Install “Eave Wadd” block or equal at facia board.

C. Second Course: Second Course: Install “Starter” shingle 4-inches from eave edge flush with end of First Course described above.

D. Install the remaining courses of thatch shingles with field shingles, stair-stepping diagonally across roof deck with manufacturer’s recommended offset pattern at succeeding courses, maintaining uniform exposure of 5 -inches.

E. At hips, bend shingle to conform to hip, install shingle spaced evenly to allow for two hip courses to one field course.

F. Fasten PVC thatch shingle with a minimum of three roofing nails through holes in binder strip, according to manufacturer’s written instructions. For shingle application at hips, nail holes may be drilled through the binder strips, or stapled with pneumatic narrow crown stainless steel staples.
Photo by Endureed

END OF SECTION
SECTION 07411 - METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: All exterior metal roof panels and associated flashing, vapor retarder, self-adhesive underlayment, sealants, and fasteners and accessories necessary to form the metal roof panel system as shown on the contract drawings and/or specified herein.

B. Related Sections:

1. Division 6 Section “Rough Carpentry”
2. Division 6 Section “Finish Carpentry”
3. Division 7 Section “Sheet Metal Flashing and Trim”
4. Division 7 Section “Joint Sealers”

1.2 REFERENCES

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

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

B. American Institute of Steel Construction (AISC):

1. Code of Standard Practice

C. American Society of Civil Engineers (ASCE):

1. ASCE-7, Minimum Design Loads for Buildings and Other Structures

D. International Code Council (ICC):

1. International Building Code (IBC)

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Uninsulated exposed fastener metal roof panel system.

1.4 SUBMITTALS

A. Submit product data, test reports, and certifications in accordance with quality assurance and performance requirements specified herein.

B. Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe the design, materials, sizes, layouts, construction details, and erection. Submit small-scale layouts of panels and large-scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations, and special details. Distinction must be made between factory and field assembled work.

1. Drawings must be approved prior to fabrication.

C. Samples:
1. Panel: Full panel width by 12 inches long.
2. Fasteners: Two (2) of each type with statement of intended use.
3. Closure: One (1) metal closure and one (1) foam closure as required.
4. Sealants: One (1) sample of each type with statement of intended use.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: The manufacturer shall have had a minimum of ten (10) years experience in the successful completion of projects employing similar materials, applications, and performance requirements.

B. Installers Qualifications: The roof systems contractor shall have had a minimum of ten (10) years experience in the successful completion of projects employing similar materials, applications, and performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be unloaded and stored per the manufacturer's instructions to prevent damage due to handling and weather.

1.7 WARRANTIES

A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and workmanship for a period of two (2) years from date of substantial completion.

B. Paint Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish for 20 years from date of substantial completion.

PART 2 PRODUCTS

2.1 METAL ROOF PANELS

A. Basis of Design Product: Subject to compliance with requirements, provide Centria Econolap ¾” exposed fastener profile or comparable product of another approved manufacturer. Profile shall have 34-2/3 inches of coverage width and ¾ inch deep symmetrical corrugations spaced at 2.67 inches c/c. Provide the named product or comparable approved equal.

1. Metal panels shall be fabricated from zinc-coated steel conforming to ASTM A 653 SQ Grade 37 with G90 coating. Material shall be minimum 22 gage with smooth surface texture.

B. All exterior flashing and trim shall be fabricated in the same material, gage, finish, and color as the exterior profile, unless otherwise noted.

2.2 FINISHES

A. Roof panel material shall be factory coil coated. Architect to select color from manufacturer's full range.

1. Exposed surface finish shall be FLUOROFINISH, consisting of 0.2-mil primer with 0.8 mil 70% Kynar 500 or Hylar 5000 color coat.

2. Concealed interior surface finish shall consist of a 0.2 mil primer and 0.3 mil backer coat.

3. Where underside of deck is exposed field paint.
2.3 ACCESSORIES AND RELATED MATERIALS

A. Roof panel system fasteners shall be #14 minimum diameter, self-tapping, with hex head.
   1. Exposed fasteners shall be 300 series stainless steel with 5/8" bonded neoprene and stainless steel washers coated to match the exterior panel color.
   2. Concealed fasteners shall be cadmium plated carbon steel.

B. Closures shall be metal and/or foam as required. Foam shall be a pre-cut profile closure of closed cell foam. Metal closures shall be fabricated from the same material, gage, finish, and color as the exterior metal panel.

C. Sealants:
   1. Hidden sealant at all side laps, end laps, and flashing details shall be gun grade non-curing butyl or polymeric non-skinning butyl tape to ensure weather tightness.
   2. Exposed sealant shall be one-part moisture curing, gun grade polyurethane.

D. Underlayment Materials
   1. Building Paper: Minimum 5 lb/100 sq. ft. (2.4 kg/sq. m), rosin sized.
   2. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

2.4 FABRICATION

A. Roof panel system components shall be fabricated in the factory for field assembly to the greatest extent possible.

PART 3 EXECUTION

3.1 INSPECTION

A. Roof panel systems contractor shall check the alignment of the structural supports. Alignment exceeding tolerances defined in the AISC Code of Standard Practice shall be corrected prior to proceeding with the installation of the wall panel system.

3.2 INSTALLATION

A. Manufacturer shall provide detailed instructions covering the tools, fasteners, sealants, and assembly procedures required to achieve the structural and weathering performance specified.

B. Metal filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.

C. The roof panel systems contractor shall coordinate work with other trades as required to insure proper flashing and seals with adjoining construction.

3.3 DAMAGED MATERIAL AND CLEANING

A. Damaged roof panels shall be repaired or replaced.

B. Inspect and approve each completed roof area and protect finished work from damage by other trades.

C. Remove all protective materials and labels from the wall components as they are installed.
D. The contractor shall be responsible for final cleaning of the roof panel system. Cleaning is to be done in accordance with the manufacturer's instructions.
SECTION 07543 - ADHERED THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adhered TPO membrane roofing system.
   2. Vapor retarder.
   3. Roof insulation.
   4. Recovery board.

B. Related Sections:
   1. Division 5 Section “Steel Decking”: Roof Deck.
   2. Division 6 Section “Rough Carpentry”: Wood nailers, curbs, and blocking.
   3. Division 7 Section “Metal Flashing and Trim”: Flashings and counterflashings.
   4. Division 7 Section “Joint Sealants”: Joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. TPO: Thermoplastic polyolefin.

B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA’s “The NRCA Roofing and Waterproofing Manual” for definitions of terms related to roofing work in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight. Comply with all local codes and standards.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 and complying with structural requirements of the project and applicable codes.

D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanical fasteners.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:
   1. Sheet Roofing: Color as specified, including T-shaped side and end lap seam.
   2. Roof insulation.
   3. Metal termination bars.
   4. Insulation Fasteners: 6 of each type, length, and finish.

D. Qualification Data: For qualified Installer and manufacturer.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in “Performance Requirements” Article.
   1. Submit evidence of compliance with performance requirements.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

H. Maintenance Data: For roofing system to include in maintenance manuals.

I. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and Birmingham Zoo's installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.6 PRODUCT HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, roof walkways, and other components of membrane roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 TPO MEMBRANE ROOFING


1. Manufacturers: Subject to compliance with requirements, provide Carlisle SynTec Incorporated; Sure-Weld TPO or comparable approved product.

2. Thickness: 60 mils, nominal.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   a. Plastic Foam Adhesives: 50 g/L.
   b. Gypsum Board and Panel Adhesives: 50 g/L.
   c. Multipurpose Construction Adhesives: 70 g/L.
   d. Fiberglass Adhesives: 80 g/L.
   e. Contact Adhesive: 80 g/L.
   f. Other Adhesives: 250 g/L.
   g. Single-Ply Roof Membrane Sealants: 450 g/L.
   h. Nonmembrane Roof Sealants: 300 g/L.
   i. Sealant Primers for Nonporous Substrates: 250 g/L.
   j. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder: Minimum of 32-mil-thick, polyethylene woven composite facer laminated to layer of rubberized asphalt adhesive; with slip-resisting surface and release paper backing; designed for direct application on roof deck without substrate board.
1. Basis-of-Design Product: Carlisle 725 TR.
2. Roll Width: 45 inches.

2.4 ROOF INSULATION

A. General: Preformed polyisocyanurate roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer’s standard sizes suitable for application, of thicknesses indicated. Provide R-30 at enclosed spaces.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Provide type recommended by roofing system manufacturer, formulated to attach roof insulation to substrate or to another insulation layer, and complying with one of the following unless otherwise indicated:

1. Modified Asphaltic Insulation Adhesive: Insulation manufacturer’s recommended modified asphalt, asbestos-free, cold-applied adhesive.


D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick, factory primed.


2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

1. Size: 30 by 30 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 5 Section "Steel Deck."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer’s written instructions. Remove sharp projections.
B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 VAPOR-RETARDER INSTALLATION
A. Self-Adhering Sheet Vapor Retarder: Install self-adhering sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.
1. Apply directly to metal roof deck.
B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.4 INSULATION INSTALLATION
A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
B. Comply with membrane roofing system and insulation manufacturer’s written instructions for installing roof insulation.
C. Install tapered insulation under area of roofing to conform to slopes indicated.
D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
G. Mechanically Fastened and Adhered Insulation on Metal Deck: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
   2. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
   1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.5 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel, if required to obtain specified warranty.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
   2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer’s written instructions.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer’s technical personnel to inspect roofing installation on completion.

B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
SECTION 07620 - METAL FLASHING AND TRIM

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes: Sheet metal flashing and trim as follows:

1. Manufactured copings.
2. Formed roof drainage systems including gutters and downspouts.
3. Formed low-slope roof flashing and trim.
4. Formed steep-slope roof flashing and trim.
5. Formed wall flashing and trim.
6. Ridge Vent System.
7. Soffit Vent System.

B. Related Sections:

1. Division 5 Section "Metal Fabrications": Metal downspout boots.
2. Division 6 Section "Rough Carpentry": Wood nailers, curbs, and blocking.
3. Division 7 Section "Adhered Thermoplastic Membrane Roofing": Installing metal flashing and trim integral with steep-slope roofing.
4. Division 7 Section "Metal Roof Panels": Installing metal flashing and trim with low roofing.
5. Division 7 Section "PVC Thatch Shingle Roofing System.
6. Division 7 Section "Joint Sealants": Field-applied sheet metal flashing and trim sealants.

1.2  PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. FMG Listing: Manufacture and install copings and roof edge flashings that are listed in FMG's "Approval Guide" and approved for Windstorm Classification, Class 1-90. Identify materials with FMG markings.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.3  SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings with performance requirements.

1.4 QUALITY ASSURANCE
A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA’s “Architectural Sheet Metal Manual.” Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.5 PRODUCT HANDLING
A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION
A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 PRODUCTS

2.1 SHEET METALS
A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
   1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
      a. Fluoropolymer 3-Coat System: Manufacturer’s standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat,
and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

b. Color: As selected by Architect from manufacturer's full range.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304; finish No. 2D (dull, cold rolled).

C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

D. Copper Sheet: ASTM B 370, cold rolled copper sheet, H00 or H01 temper.
   1. Non-painted exposed finish: Mill

2.2 UNDERLAYMENT MATERIALS


B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
   1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
   2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.

C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

K. Splash Blocks: Precast concrete, 2500 psi minimum, with smooth finish; style as indicated or as selected by Architect from full range of industry patterns available.

2.4 MANUFACTURED COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Metal-Era, Inc.
   b. MM Systems Corporation.
   c. Perimeter Systems, a division of Southern Aluminum Finishing Co.

2. Coping Caps: Snap-on, fabricated from the following exposed metal:
   a. Aluminum: 0.050 inch thick.

3. Coping Cap Color: As selected by Architect from manufacturer's full range.


5. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches wide, 0.028 inch thick, with integral cleats.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.


2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
1. Thickness: As recommended by SMACNA’s "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen, wire ball downspout strainer, and valley baffles.
2. Material: Aluminum; 0.050 inch thick.

B. Downspouts: Fabricate round, downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Stainless Steel, 0.0187 inch thick.

B. Counterflashing: Aluminum; 0.0320 inch thick.

C. Roof-Penetration Flashing: Lead; 4.0 lb/sq. ft., hard tempered.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Aluminum; 0.0320 inch thick.

B. Drip Edges: Aluminum; 0.0320 inch thick.

C. Eave, Rake, Ridge and Hip Flashing: Aluminum; 0.0320 inch thick.

D. Base Flashing: Aluminum; 0.040 inch thick.

E. Counterflashing: Aluminum; 0.0320 inch thick.

F. Roof-Penetration Flashing: Lead; 4.0 lb/sq. ft., hard tempered.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams.

1. Material: Stainless Steel; 0.0156 inch thick.

B. Openings Flashing in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high end dams.

1. Material: Stainless Steel; 0.0156 inch thick.

2.10 RIDGE VENT SYSTEM
A. Basis of design product: By Air Vent, Inc. (1-800-Air-Vent). Venturi Vent PWS and Peak FilterVent or approved equivalent. Provide ridge cap flashing to match roof.

2.11 SOFFIT VENT SYSTEM

A. Provide continuous aluminum soffit vent. Finish to be selected by architect.
   1. Air Vent Inc. – Model SV202

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

   1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

   1. Coat side of stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
   1. Aluminum: Use aluminum or stainless-steel fasteners.
   2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with butyl sealant as required for watertight construction.
   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
   1. Do not solder aluminum sheet.
   2. Pretinning is not required for lead.
   3. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
   4. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to resist uplift and outward forces according to performance requirements.
   1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at 30-inch centers.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION
A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with butyl sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets or straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Provide gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.
2. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Connect downspouts to underground drainage system, unless otherwise indicated.
2. Provide elbows and splash blocks at base of downspout to direct water away from building, where indicated.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant.

1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Openings Flashing in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.7 CLEANING AND PROTECTION
A. Clean and neutralize flux materials. Clean off excess solder and sealants.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

B. Related Sections:

1. Division 7 Section "Fire-Resistive Joint Systems": Joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Source Limitations: Obtain penetration firestopping systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.

b. Classification markings on penetration firestopping correspond to designations listed by the following:

1) UL in its "Fire Resistance Directory."

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.5 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

2. Grace Construction Products.
3. Hilti, Inc.
5.Specified Technologies Inc.
6. 3M Fire Protection Products.
8. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-wool-fiber or rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Joints in or between fire-resistance-rated constructions.

B. Related Sections:
   1. Division 7 Section "Penetration Firestopping": Penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
   1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Source Limitations: Obtain fire-resistive joint systems, for each kind of construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
   1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
      a. Fire-resistive joint system products bear classification marking of qualified testing agency.
      b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
1) UL in its "Fire Resistance Directory."

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.5 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Fire Trak Corp.
   c. Grace Construction Products.
   d. Hilti, Inc.
   e. Johns Manville.
   f. Specified Technologies Inc.
   g. 3M Fire Protection Products.
   i. USG Corporation.

C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.
E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION
SECTION 07920 - JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   b. Control and expansion joints in unit masonry.
   c. Joints between metal panels.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   f. Control and expansion joints in ceilings and other overhead surfaces.
   g. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Joints between different materials.
   c. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   g. Joints between counters, backsplashes, and adjoining walls.
   h. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

B. Related Sections:

1. Division 7 Section "Metal Flashing and Trim": Sealing joints related to flashing and sheet metal.
2. Division 8 Section "Glazing": Glazing sealants.
3. Division 9 Section "Gypsum Board": Sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Division 9 Section "Acoustical Panel Ceilings": Sealing edge moldings at perimeters of acoustical ceilings.

1.2 PERFORMANCE REQUIREMENTS
A. Provide elastomeric joint sealants for exterior applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing joint sealants similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
   5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in the Joint Sealant Schedule at end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.3 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

3. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

B. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
D. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.4 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry and unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.

   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to the first method below, in Appendix X1 in ASTM C 1193, or another of the listed methods as appropriate for type of joint-sealant application indicated:


3. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.

5. Inspect tested joints and report on the following:

   a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

   b. Whether sealants filled joint cavities and are free of voids.

   c. Whether sealant dimensions and configurations comply with specified requirements.

6. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

7. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION
A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT SEALANT SCHEDULE

A. Multicomponent Epoxy-Resin Security Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ChemRex; Sonneborn Epolith-G.
   c. Thiokol; T-2407.

2. Compression Strength: 11,000 psi; ASTM D 695.
3. Tensile Strength: 900 psi; ASTM D 638.
4. Elongation: 50 percent; ASTM D 638.
5. Shore D Hardness: Not less than 70; ASTM C 661.
6. Applications: Joints subject to contact by animals.

B. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; 898.
   b. Tremco; Tremsil 600 White.

2. Type and Grade: S (single component) and NS (nonsag).
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Perimeter joints of plumbing fixtures, counters and backsplashes; and perimeter joints in ceramic tile.

C. Multicomponent Nonsag Urethane Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; Dynatrol II.
   b. Tremco; Dymeric 511.
   c. Tremco; Vulkem 922.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Exterior non-traffic building joints in building walls, soffits, glazing assemblies, and horizontal surfaces above grade not indicated for another type of sealant.

D. Multicomponent Pourable Urethane Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
b. Meadows, W. R., Inc.; POURTHANE.
c. Pecora Corporation; Urexpan NR-200.
d. Tremco; THC-900.
e. Tremco; Vulkem 245.

2. Type and Grade: M (multicomponent) and P (pourable).
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
6. Applications: Joints in paving not indicated for another type of sealant.

E. Single-Component Nonsag Urethane Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
   b. Sonneborn, Division of ChemRex Inc.; Ultra.
   c. Sonneborn, Division of ChemRex Inc.; NP 1.
   d. Pecora Corporation; Dynatrol I-XL.
   e. Tremco; DyMonic.

2. Type and Grade: S (single component) and NS (nonsag).
4. Use Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Interior joints not indicated for another type of sealant.

F. Single-Component Pourable Urethane Sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Sika Corporation, Inc.; Sikaflex - 1CSL.
   b. Sonneborn, Division of ChemRex Inc.; SL 1.
   c. Tremco; Vulkem Nova 300 SSL.

2. Type and Grade: S (single component) and P (pourable).
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
6. Applications: Interior joints in traffic surfaces not indicated for another type of sealant.

G. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bostik Findley; Chem-Calk 600.
   b. Pecora Corporation; AC-20+.
   c. Sonneborn, Division of ChemRex Inc.; Sonolac.
   d. Tremco; Tremflex 834.

2. Applications: Interior non-movement and non-traffic joints not indicated for another type of sealant.

H. Acoustical Sealant for Exposed and Concealed Joints:

1. Products: Subject to compliance with requirements, provide one of the following:
a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.


I. Acoustical Sealant for Concealed Joints:

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

   a. Pecora Corporation; BA-98.
   b. Tremco; Tremco Acoustical Sealant.

END OF SECTION
SECTION 08110 - STEEL DOORS AND FRAMES

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes: Hollow metal doors and frames.

B. Related Sections:
   1. Division 8 Section "Finish Hardware": Door hardware for hollow metal doors.
   2. Division 8 Section "Glazing": Glazed lites in hollow metal doors and frames.
   3. Division 9 Sections "Paints and Coatings": Field painting hollow metal doors and frames.

1.2  DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.3  SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material
descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
   8. Details of moldings, removable stops, and glazing.
   9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of
supplier, using same reference numbers for details and openings as those on Drawings.
Coordinate with door hardware schedule.

1.4  QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.5  PRODUCT HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and
Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded
to jambs and mullions.
C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Fleming Door Products Ltd.; an Assa Abloy Group company.
7. Kewanee Corporation (The).
8. Mesker Door Inc.
10. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 8 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel, unless otherwise indicated.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
   a. Thermal-Rated (Insulated) Doors: Provide exterior doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

3. Vertical Edges for Single-Acting Doors: Beveled edge; 1/8 inch in 2 inches, unless otherwise indicated.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
2. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), as indicated.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Fabricate frames from 0.067-inch thick (14 gage) steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
   1. Fabricate frames for indicated doors from metallic-coated sheet.
   2. Fabricate frames with mitered or coped corners.
   3. Fabricate frames as full profile welded unless otherwise indicated.
   4. Fabricate frames from 0.053-inch thick (16 gage) steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
   3. Postinstalled Expansion Type for In-Place Concrete: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

D. Terminated Stops: Where indicated on interior door frames, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
   1. Provide terminated stops unless otherwise indicated.

2.7 ACCESSORIES
A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117 unless otherwise indicated.

1. Fabricate custom hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Two anchors per jamb up to 60 inches high.
      2) Three anchors per jamb from 60 to 90 inches high.
      3) Four anchors per jamb from 90 to 120 inches high.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
c. **Postinstalled Expansion Type**: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. **Door Silencers**: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. **Single-Door Frames**: Drill stop in strike jamb to receive three door silencers.
   b. **Double-Door Frames**: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. **Hardware Preparation**: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8 unless otherwise indicated; or according to ANSI/NAAMM-HMMA 861 for custom hollow-metal work.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.

G. **Stops and Moldings**: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. **Single Glazed Lites**: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. **Multiple Glazed Lites**: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow metal work.
   5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 **STEEL FINISHES**

A. **Prime Finish**: Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. **Shop Primer**: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 EXECUTION

3.1 **EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer’s written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 unless otherwise indicated; comply with HMMA 840 for custom hollow-metal work.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   b. Install frames with removable glazing stops located on secure side of opening.
   c. Install door silencers in frames before grouting.
   d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

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Birmingham Zoo
June 24, 2009
3. **Metal-Stud Partitions:** Solidly pack mineral-fiber insulation behind frames.
4. **Masonry Walls:** Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. **Concrete Walls:** Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. **In-Place Concrete Construction:** Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. **Ceiling Struts:** Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
8. **Installation Tolerances:** Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   - **Squareness:** Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   - **Alignment:** Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   - **Twist:** Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   - **Plumbness:** Plus or minus 1/16 inch, measured at jambs at floor.

C. **Hollow Metal Doors:** Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
   1. **Jambs and Head:** 1/8 inch plus or minus 1/16 inch.
   2. **Between Edges of Pairs of Doors:** 1/8 inch plus or minus 1/16 inch.
   3. **Between Bottom of Door and Top of Threshold:** Maximum 3/8 inch.
   4. **Between Bottom of Door and Top of Finish Floor (No Threshold):** Maximum 3/4 inch.

D. **Glazing:** Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 **ADJUSTING AND CLEANING**

A. **Final Adjustments:** Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. **Remove grout and other bonding material from hollow metal work immediately after installation.**

C. **Prime-Coat Touchup:** Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. **Metallic-Coated Surfaces:** Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION
SECTION 08310 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall access doors and frames.
   2. Ceiling access doors and frames.
   3. Floor doors and frames.

B. Provide access doors where required for access to concealed equipment, in sizes and locations as acceptable to Architect.

C. Related Sections:
   1. Division 9 Section "Paints and Coatings": Field painting access doors.

1.2 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, and finishes for access doors and frames.

B. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

1.4 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Bilco Company (The).
   2. J. L. Industries, Inc.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, and surface defects; pickled and oiled; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M.

C. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to
ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

2.3 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Paints and Coatings."

B. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.

2.4 ACCESS DOORS AND PANELS

A. Access Doors and Frames:
   1. Metal: Metallic-coated steel.
   2. Door: Minimum 0.060-inch-thick sheet metal, set flush with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch-thick sheet metal.
   4. Frame Edge Condition: Surface-mounted trim.
   5. Hinges: Continuous piano hinge.
   6. Lock: Key-operated cylinder lock.
   7. Rated: As indicated in drawings.

2.5 FLOOR DOORS

A. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.

B. Watertight Floor Door: 1/8" aluminum plate cover and 1/4" aluminum angle frame, diamond-pattern, tread plate door; loading capacity to support 105-lbf/sq. ft. pedestrian live load.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide The Bilco Company; Type SM.
   4. Hardware Material: Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.
   5. Lift Assistance: Gas strut
   6. Padlock hasp
   7. Safety posts and chain
   8. Size: As indicated on drawings.

2.6 FABRICATION

A. General: Provide access door assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.7 FINISHES, GENERAL

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.8 METALLIC-COATED STEEL FINISHES

A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.


C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

2.9 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.1 PREPARATION
A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer’s written instructions for installing access doors and floor doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install floor doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Service doors, electrically operated.
   2. Service doors, chain operated.

B. Related Section:
   1. Division 3 Section "Cast-in-Place Concrete" for concrete walls.
   2. Division 4 Section "Reinforced Unit Masonry Assemblies" for CMU walls.
   3. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
   4. Division 16 Sections Electrical Service and Connections for powered operators and accessories.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
   1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.

1.3 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Show locations of replaceable fusible links.
   3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

E. Maintenance Data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
PART 2 PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.3 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.4 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

2.5 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.
2.5 MANUAL DOOR OPERATORS

A. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf (111 N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.7 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.

1. Electrical Characteristics: 60 Hertz, phase and voltage per manufacturer.
2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.


F. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

G. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.8 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation, Model 615 or comparable product of an approved manufacturer.

B. Operation Cycles: Not less than 20,000.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Curved.
   1. Vision Panels: Approximately 10- by 1-5/8-inch openings spaced approximately 2 inches apart and beginning 12 inches from end guides; in two rows of slats; installed with vision-panel glazing.

E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

F. Hood: Match curtain material and finish.
   1. Shape: Round.
   2. Mounting: As shown on Drawings.

G. Locking Devices: Equip door with slide bolt for padlock.


I. Electric Door Operator:
   1. Usage Classification: Medium duty, up to 15 cycles per hour.
   4. Remote-Control Station: Where shown on Drawings.

J. Door Finish:
   1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Fire-Rated Doors: Install according to NFPA 80.

C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

D. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.
3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION
SECTION 08460 - AUTOMATIC ENTRANCE DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Exterior and interior, sliding, power-operated automatic entrances.

B. Related Sections:
   1. Division 16 Sections: Electrical connections including conduit and wiring for automatic entrance operators.

1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.


D. Safety Device: Device that, to avoid injury, prevents a door from opening or closing.

E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design automatic entrances, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

   1. Wind Loads:
      a. Basic Wind Speed: 90 mph.
      b. Importance Factor: 1.0.
      c. Exposure Category: B.

   C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

      1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Operating Temperature Range: Provide automatic entrances that operate within minus 20 to plus 122 deg F.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

F. Opening-Force Requirements:
1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.

G. Entrapment Force Requirements:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Activation and safety devices.
4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For automatic entrances indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for seismic restraints.

F. Qualification Data: For Installer, manufacturer, and certified inspector.

G. Product Certificates: For each type of automatic entrance, from manufacturer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for automatic entrances.

I. Field quality-control reports.

J. Maintenance Data: For automatic entrances, safety devices, and control systems to include in maintenance manuals.

K. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

D. Source Limitations for Automatic Entrances: Obtain automatic entrances from single source from single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Power-Operated Door Standard: BHMA A156.10.

G. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Templates: Obtain templates for doors, frames, and other work specified to be factory prepared for installing automatic entrances, and distribute to parties involved. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.

C. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including, but not limited to, excessive deflection.
   b. Faulty operation of operators, controls, and hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: 2 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of automatic entrance Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

   1. Engage a certified inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
   2. Perform maintenance, including emergency callback service, during normal working hours.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   2. Sheet and Plate: ASTM B 209.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

C. Glazing: As specified in Division 8 Section "Glazing"

D. Sealants and Joint Fillers: As specified in Division 7 Section "Joint Sealants."

E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.

F. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil thickness per coat.

G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.2 SLIDING AUTOMATIC ENTRANCES
A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

B. Sliding Automatic Entrance:

1. Basis-of-Design Product: The design for automatic entrance doors is based on Horton Automatics; Div. of Overhead Door Corporation; Series 2003 Belt Drive, Type 110. Subject to compliance with requirements, provide the named products or comparable product by another approved manufacturer.

2. Configuration: Single-slide door, O-SX, or as indicated on drawings.
   a. Traffic Pattern: Two way.
   c. Mounting: Between jambs.

3. Operator Features:
   a. Power opening and closing.
   b. Drive System: Electric belt drive.
   c. Microprocessor Master Control: Horton Version 2 software; with programmable speed values for open speed, close speed, open check, close check, and open cushion.
   d. Adjustable opening and closing speeds.
   e. Adjustable hold-open time between 0 and 30 seconds.
   f. Obstruction recycle.
   g. On-off/hold-open switch to control electric power to operator, key operated.
   h. Energy-conservation switch that reduces door-opening width.

4. Sliding Door Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
   a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

5. Sliding Door Threshold: Manufacturer's standard threshold members and bottom-guide track system, with stainless-steel, ball-bearing-center roller wheels.

6. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.

7. Safety Devices: Two photoelectric beams mounted in sidelite jambs to detect pedestrians in presence zone and to prevent door from closing.


2.3 ENTRANCE COMPONENTS

A. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch-thick, glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

2. Stile Design: Narrow stile, 2-1/8-inch nominal width unless otherwise indicated.
3. Rail Design: 5-inch nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish. Applied muntins as indicated on drawings.

C. Sidelites: Manufacturer's standard 1-3/4-inch-deep sidelites with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members matching door design and finish.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design. Applied muntins as indicated on drawings.

D. Headers: Fabricated from minimum 0.125-inch-thick, extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Concealed, with one side of header flush with framing.
2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.

   a. Provide sag rods for spans exceeding 14 feet.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Signage: Affixed to both sides of each door as required by BHMA A156.10 for type of door and its operation.

1. Application Process: Door manufacturer's standard process.
2. Provide sign materials with instructions for field application after glazing is installed.

2.4 DOOR OPERATORS AND ACTIVATION AND SAFETY DEVICES

A. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

1. Door Operator Performance: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.

B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds.

1. Provide capability for switching between bidirectional and unidirectional detection.
C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.5 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Provide breakaway device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be 50 lbf according to BHMA A156.10. Interrupt powered operation of door operator while in breakaway mode.

C. Deadlocks: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch-long throw bolt; BHMA A156.5, Grade 1.
   1. Cylinders: As specified in Division 8 Section "Door Hardware."
   2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.

D. Weather Stripping: Manufacturer's standard replaceable components.
   1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
   2. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
   3. Weather Sweeps: Manufacturer's standard nylon brush sweep mounted to underside of door bottom.

2.6 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
   1. Form aluminum shapes before finishing.
   2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
   3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
      a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
      b. Reinforce members as required to receive fastener threads.
   4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
   1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
   2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors.

G. Activation and Safety Devices:

1. General: Factory install devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
   b. Bottom Beam: 24 inches.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION
3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

B. Entrance: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.

2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.

4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 16 Sections.

D. Activation and Safety Devices: Install and adjust devices to provide detection field and functions indicated.

E. Glazing: Install glazing as specified in Division 8 Section "Glazing."

F. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants" to provide weathertight installation.

1. Set bottom-guide track system, framing members and flashings in full sealant bed.

2. Seal perimeter of framing members with sealant.

G. Signage: Apply signage on both sides of each door as required by referenced door standards.

H. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

A. Inspection: Engage Installer's certified inspector to test and inspect automatic entrances and prepare test and inspection reports.

1. Certified inspector shall test and inspect each automatic entrance to determine compliance of installed systems with applicable BHMA standards.

2. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.
B. Work will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in BHMA A156.10.

B. Lubricate operating hardware and other moving parts as recommended by manufacturer.

C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING AND PROTECTION

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Division 8 Section "Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION
SECTION 08520 - ALUMINUM WINDOWS

PART 1 GENERAL

1.1  SUMMARY
A.  Section Includes:
   1.  Fixed aluminum-framed windows for exterior locations.
   2.  Self Closing Pass-Through Window for exterior locations
B.  Related Sections:
   1.  Division 8 Section "Glazing": Glazing requirements for aluminum windows, including those specified to be factory- or site-glazed units.

1.2  DEFINITIONS
A.  Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
   1.  AW: Architectural Window.
B.  Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
   1.  Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.
C.  Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
D.  Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.3  PERFORMANCE REQUIREMENTS
A.  General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS for gateway performance for both gateway performance and optional performance grade.
B.  Structural Performance: Design to conform with local applicable codes. Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
   1.  Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings and complying with structural requirements of the project and applicable codes.
   2.  Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.
C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
5. Flashing and drainage details.
8. Glazing details.
10. Include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum windows and used to determine the following:

   a. Structural test pressures and design pressures from wind loads indicated.
   b. Deflection limitations of glass framing systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below.

1. Main Framing Member: 12-inch-long, full-size sections of extrusions with factory-applied color finish.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Qualification Data: For Installer and professional engineer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

H. Maintenance Data: For operable window sash, operating hardware, weather stripping, window system operators and finishes to include in maintenance manuals.

I. Warranty: Special warranty specified in this Section.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
   1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

   1. Provide AAMA-certified or WDMA-certified aluminum windows with an attached label.

E. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
      b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
      c. Faulty operation of movable sash and hardware.
      d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
      e. Failure of insulating glass.
2. **Warranty Period:**
   a. Window: 2 years from date of Substantial Completion.
   b. Glazing: 10 years from date of Substantial Completion.
   c. Metal Finish: 20 years from date of Substantial Completion.

**PART 2 PRODUCTS**

2.1 **MANUFACTURERS**

A. **Fixed Aluminum Window:** Basis-of-Design Window Product: Subject to compliance with requirements, provide the following products of EFCO Corporation, or approved comparable products:
   1. Series 510, 2-7/16” deep frame heavy commercial.

B. **Self Closing Pass-Through Window:** Basis-of-Design Window Product: Subject to compliance with requirements, provide the following products of Quikserv Corp. P.O. Box 40466 Houston, TX 77240-0466, Tel: 713-849-5882, Fax: 713-849-5708, or approved comparable products:
   1. Model IFSC-4030 (Self Closing Fully Insulated Single Horizontal Sliding Window Unit):
      1) Service Opening: 20-1/4 inches (w) x 29 inches (h).
      2) Rough Opening: 48-3/8 (w) x 36-3/8 (h).
      3) Finish: Bronze
      4) Hand: As indicated on drawings
      5) Glazing: 5/8” insulated glazing

2.2 **MATERIALS**

A. **Aluminum Extrusions:** Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. **Fasteners:** Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
   1. **Reinforcement:** Where fasteners screw anchor into aluminum less than 0.125-inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, non-corrosive, pressed-in, splined grommet nuts.
   2. **Exposed Fasteners:** Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. **Anchors, Clips, and Accessories:** Aluminum, non-magnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. **Reinforcing Members:** Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.

1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/1.S.2/NAFS.

F. Replaceable Weather Seals: Comply with AAMA 701/702.

G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 ALUMINUM WINDOWS

A. Window Type: Fixed and sliding as indicated on Drawings.

B. AAMA/WDMA Performance Requirements: Provide aluminum windows of Performance Class and Grade indicated below that comply with AAMA/WDMA 101/1.S.2/NAFS unless more stringent performance requirements are indicated:

1. AW-90.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, as follows:

1. CRF-frame 56; CRF-glass 66.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503, as follows:

1. 0.52 Btu/sq. ft. x h x deg F / 0.40 Btu/sq. ft. x h x deg F or less.

E. Air Infiltration: Maximum rate not more than indicated below when tested according to AAMA/WDMA 101/1.S.2/NAFS, Air Infiltration Test:

1. Maximum Rate: 0.1-cfm/sq. ft. of area at an inward test pressure of 6.24-lbf/sq. ft.

F. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/1.S.2/NAFS, Water Resistance Test:

1. Test Pressure: 20 percent of positive design pressure, but not more than 15 lbf/sq. ft.

G. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/1.S.2/NAFS.


2.4 GLAZING

A. Glass and Glazing Materials: Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
B. Glazing System: Manufacturer’s standard factory-glazing system that produces weathertight seal.

2.8 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.

2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.

3. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

F. Mullions and Closures: Provide mullions, trim, closures and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions, closures and cover plates capable of withstanding design loads of window units.

G. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch-thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

H. Sill Extensions: Provide sills with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.

I. Muntins: Provide triple muntin application with internal between glazing in configuration shown. No muntins to be siliconized or taped. Must be glazed into glazing pocket. Provide bevel profile muntin with perimeter bevel to match.

J. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 8 Section “Glazing” and with AAMA/WDMA 101/I.S.2/NAFS.
K. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.9 FINISHES, GENERAL

A. Comply with NAAMM’s "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, accurate locations of connections to building electrical system; and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.
   3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

F. Connect automatic operators to building electrical system.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain window operating system.

END OF SECTION
SECTION 08620 - UNIT SKYLIGHTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Curb mounted unit skylights.

B. Related Sections:
   1. Division 6 Section "Rough Carpentry": Wood blocking at unit skylights.
   2. Division 7 Section "Metal Flashing and Trim": Flashing at unit skylights.

1.2 SUBMITTALS

A. Product Data: For each type of unit skylight indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for unit skylights.

B. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

C. Samples for Initial Selection: For unit skylights with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer's standard size.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type and size of unit skylight.

F. Maintenance Data: For unit skylights to include in maintenance manuals.

G. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of units required for this Project.

C. Source Limitations: Obtain unit skylights from single source from single manufacturer.

D. Surface-Burning Characteristics of Plastic Glazing: Provide plastic glazing sheets identical to those tested for fire-exposure behavior per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

   1. Self-Ignition Temperature: 650 deg F or more for plastic sheets in thickness indicated when tested per ASTM D 1929.
   2. Smoke-Production Characteristics: Comply with either requirement below:
      a. Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic sheets in manner indicated for use.
      b. Smoke Density: 75 or less when tested per ASTM D 2843 on plastic sheets in thickness indicated for use.
   a. Acrylic Glazing: Class CC2, burning rate of 2-1/2 inches per minute or less for
      nominal thickness of 0.060 inch or thickness indicated for use.

   Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass
   Doors,” for minimum standards of performance, materials, components, accessories, and
   fabrication. Comply with more stringent requirements if indicated.

1. Provide AAMA-certified unit skylights with an attached label.

1.4 COORDINATION
   A. Coordinate unit skylight flashing requirements with roofing system.
   B. Provide anchors and inserts to be placed in adjacent construction in proper sequence so as not
      to delay the Work.

1.5 WARRANTY
   A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or
      replace components of unit skylights that fail in materials or workmanship within specified
      warranty period.

1. Failures include, but are not limited to, the following:
   a. Uncontrolled water leakage.
   b. Deterioration of metals, metal finishes, and other materials beyond normal
      weathering.
   c. Yellowing of acrylic glazing.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Basis-of-Design Product: Subject to compliance with requirements, provide Bristolite Skylights
      Energy Star Model ES-CM-1-ESA-1R-HW-MF, or comparable product of another approved
      manufacturer.

2.2 MATERIALS
   A. Aluminum Components:

   1. Sheets: ASTM B 209, alloy and temper to suit forming operations and finish requirements
      but with not less than the strength and durability of alclad Alloy 3005-H25.
   2. Extruded Shapes: ASTM B 221, alloy and temper to suit structural and finish
      requirements but with not less than the strength and durability of Alloy 6063-T52.

   B. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other
      noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match
      material being fastened.

   1. Where removal of exterior exposed fasteners might allow access to building, provide
      nonremovable fastener heads.
2.3 GLAZING
   B. Glazing Gaskets: EPDM, neoprene, partially vulcanized butyl tape, or liquid-applied elastomeric sealant.

2.4 INSTALLATION MATERIALS
   A. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, formulated for 15-mil dry film thickness per coating.
   B. Joint Sealants: As specified in Division 7 Section "Joint Sealants."
   C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
   D. Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

2.5 UNIT SKYLIGHTS
   A. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.
   B. Unit Shape and Size: Indicated on drawings.
   C. Condensation Control: Fabricate unit skylights with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.
   D. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.
   E. Protective Screens: Manufacturer's standard to protect personnel from falls.

2.6 GENERAL FINISH REQUIREMENTS
   A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES
   A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION
A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with unit skylight installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

C. Install unit skylights level, plumb, and true to line, without distortion.

D. Anchor unit skylights securely to supporting substrates.

E. Where metal surfaces of unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by unit skylight manufacturer.

F. Set unit skylight flanges in thick bed of roofing cement to form a seal unless otherwise indicated.

G. Where cap flashing is indicated, install to produce waterproof overlap with roofing or roof flashing. Seal with thick bead of mastic sealant except where overlap is indicated to be left open for ventilation.

3.3 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION
SECTION 08710 - FINISH HARDWARE

1. GENERAL

1.01 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
   1. Door hardware for steel (hollow metal) doors.
   2. Door hardware for other doors indicated.
   3. Keyed cylinders as indicated.

B. Intent of Hardware Groups
   1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
   2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.02 SUBSTITUTIONS:

A. Comply with Section 01600

1.03 SUBMITTALS:

A. Comply with Section 01300

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:
   1. Detailed specification of construction and fabrication.
   2. Manufacturer's installation instructions.
   3. Submit 6 copies of catalog cuts with hardware schedule.

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.
   1. List groups and suffixes in proper sequence.
   2. Completely describe door and list architectural door number.
   3. Manufacturer, product name, and catalog number.
   4. Function, type, and style.
   5. Size and finish of each item.
   7. Explanation of abbreviations and symbols used within schedule.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

F. Contract Closeout Submittals: Comply with Section 01700 including specific requirements indicated.
   1. Operating and maintenance manuals: Submit 3 sets containing the following.
      a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

A. Comply with Section 01400.
1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
   a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
   b. Hardware Schedule shall be prepared and signed by an AHC.
   c. Available training for installers on the proper installation of hardware.
4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
   a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
   b. Underwriters Laboratories requirements have precedence over this specification where conflicts exist.
6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Fire Rated Openings:
1. NFPA 80 compliant
2. Hardware UL10C/UBC Standard 7-2 (positive pressure) compliant.
3. Provide proper latching hardware, self closing, approved bearing hinges, and seals.

C. Review Project for extent of finish hardware required completing the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

D. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Convene at least one week prior to commencement of related work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Section 01600.
1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.
1.06 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.07 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer’s Warranty:
   1. Closers: Ten years
   2. Exit Devices: Three Years
   3. Locksets & Cylinders: Three years
   4. All other Hardware: Two years.

1.08 OWNER’S INSTRUCTION:

A. Instruct Owner’s personnel in operation and maintenance of hardware units.

1.09 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra service materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
   1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
   2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
   3. Delivery, Storage and Protection: Comply with Owner’s requirements for delivery, storage and protection of extra materials.

B. Maintenance Service: Submit for Owner’s consideration maintenance service agreement for electronic products installed.

2. PRODUCTS

2.01 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

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<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
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<tbody>
<tr>
<td>Hinges</td>
<td>Stanley</td>
<td>Hager, McKinney</td>
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<tr>
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<td>Best</td>
<td>No Substitution</td>
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<td>Exit Devices</td>
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<tr>
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<tr>
<td>Thresholds &amp; Gasketing</td>
<td>Pemko</td>
<td>NGP, Reese, Zero</td>
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2.02 MATERIALS:

A. Hinges:
1. Template screw hole locations
2. Minimum of 2 permanently lubricated non-detachable bearings
3. Equip with easily seated, non-rising pins
4. Sufficient size to allow 180-degree swing of door
5. Furnish hinges with five knuckles and bearings
6. Provide hinge type as listed in schedule.
7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
9. UL10B listed for Fire

B. Mortise Type Locks and Latches:
1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C
2. Fit ANSI A115.1 door preparation
3. Functions and design as indicated in the hardware groups
4. One-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
5. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
6. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
7. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
8. Provide sufficient curved strike lip to protect door trim
9. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
10. Lock shall have self-aligning, thru-bolted trim
11. Levers to operate a roller bearing spindle hub mechanism
12. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
13. Spindle to be designed to prevent forced entry from attacking of lever
14. Provide locksets with 7-pin removable and interchangeable core cylinders
15. Each lever to have independent spring mechanism controlling it
16. Core face must be the same finish as the lockset

C. Exit Devices shall:
1. Tested and approved by BHMA for ANSI 156.3, Grade 1
2. Provide a deadlocking latchbolt
3. Non-fire rated exit devices shall have cylinder dogging.
4. Touchpad shall be “T” style
5. Exposed components shall be of architectural metals and finishes.
6. Lever design shall match lockset lever design
7. Provide strikes as required by application.
8. Fire exit devices to be listed for UL10C
9. UL listed for Accident Hazard
10. Provide vandal resistant or breakaway trim
11. Aluminum vertical rod assemblies are acceptable only when provide with the manufacturers optional top and bottom stainless steel rod guard protectors

D. Cylinders:
1. Provide necessary cylinder housings, collars, rings, & springs as recommended by manufacturer's for proper installation. Provide in dimensions that accommodate flush mounting conditions where possible.
2. Provide proper cylinder cams as required to operate locksets.
3. Coordinate and provide as required for related sections.
E. Door Closers shall:
1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Closer shall have extra-duty arms and knuckles
4. Conform to ANSI 117.1
5. Maximum 2 7/16 inch case projection with non-ferrous cover
6. Separate adjusting valves for closing and latching speed, and backcheck
7. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
8. Full rack and pinion type closer with 1 1/2" minimum bore
9. Mount closers on non-public side of door, unless otherwise noted in specification
10. Closers shall be non-handed, non-sized and multi-sized 1 through 6

F. Kickplates: Provide with four beveled edges, height as specified by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish pan-head countersunk screws to match finish.

G. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

H. Thresholds: As specified and per details. Provide sizes not to exceed frame depth. Maximum height of 1/2" at ADA required openings. Coordinate with door bottom and door undercut.

I. Key Control: Provide into existing series key cabinet complete with hooks, index and tags.

J. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.03 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING:

A. Provide keyed construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best MX-8 small format 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate".

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:
1 each Grand Masterkeys
4 each Masterkeys
2 each Change keys each keyed core
15 each Construction masterkeys
1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

3. EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
   1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
   1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
   2. NWWDA Industry Standard I.S.1.7, Hardware Locations for Wood Flush Doors.

3.03 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. ADA Standard: Conform to ANSI A117.1 for positioning requirements for disabled.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

E. Thresholds: Set thresholds for doors in full bed of sealant complying with requirements specified in Division 7 Section “Joint Sealants.

F. Mount cylinder keyways in proper position as recommended by manufacturers.

G. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.

H. Replace fasteners damaged by power-driven tools.

3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

Trails of Africa
Birmingham Zoo
June 24, 2009
A. Contractor/Installer Field Services: After installation is complete, Contractor shall inspect completed door openings on site to verify installation of hardware is complete and properly adjusted. Compensate for final operation of heating and ventilating equipment.

1. Check and adjust closers to ensure proper operation.
   a. Adjust closer to complete full closing cycle in less than 4 to 6 seconds without abrupt change of speed between “Sweep” and “Latch” speeds.
   b. Adjust “Backcheck” according to manufacturer’s instructions.
   c. Set exterior doors closers to have 8.5 lbs maximum pressure to open, interior non-rated at 5 lbs, rated openings at 12 lbs

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
   a. Verify levers are free from binding.
   b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to the Architect and Hardware Supplier outlining corrective actions and recommendations.

3.05 SCHEDULE OF FINISH HARDWARE:

A. Manufacturer’s Abbreviations:
   1. ST    Stanley
   2. BE    Best
   3. RO    Rockwood
   4. PR    Precision
   5. AB    Architectural Builders Hardware
   6. PE    Pemko
Hardware Sets

SET #1

DOORS 500A, 500B
EACH TO HAVE:

BEST CYLINDERS AS REQUIRED
ALL OTHER HARDWARE BY DOOR SUPPLIER

SET #2

DOOR 501A
EACH TO HAVE:

1 EACH CONT. HINGE 661HD ALUM
1 EACH EXIT DEVICE 2108CD X 4908A X S300 X 630
1 EACH RIM CYLINDER 1E72 X 626
1 EACH MORTISE CYLINDER 1E74 X C4 X 626
1 EACH CLOSER D4550CS X SN X 689
1 EACH KICKPLATE 10" X 2" LTDW X 630
1 EACH THRESHOLD 158A
1 EACH DOOR SHOE 216AV
1 SET WEATHERSTRIPING 303AS
3 EACH SILENCERS 608

SET #3

DOORS 200B, 505A
EACH TO HAVE:

6 EACH BUTTS FBB 199 4.5 X 4.5 NRP 630
1 EACH LOCKSET 45H7D16J 630
1 SET AUTO FLUSH BOLTS 1842 X 626
2 EACH CLOSERS D4550CS X SN X 689
2 EACH KICKPLATES 10" X 1" LTDW X 630
1 EACH THRESHOLD 271A
2 EACH DOOR SHOES 216AV
1 SET WEATHERSTRIPING 303AS
2 EACH SILENCERS 608

SET #4

DOORS 506A, 515A, 516A
EACH TO HAVE:

3 EACH BUTTS FBB 191 4.5 X 4.5 NRP 630
1 EACH LOCKSET 45H7D16J 630
1 EACH CLOSER D4550CS SN 689
1 EACH THRESHOLD 271A
1 EACH DOOR SHOE 216AV
1 SET WEATHERSTRIPING 303AS
3 EACH SILENCERS 608
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<tr>
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<td>661HD ALUM</td>
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<td>1 EACH DEADLOCK</td>
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<td>3 EACH SILENCERS</td>
<td>608</td>
<td></td>
</tr>
</tbody>
</table>
SET #8

DOORS: 301A, 519A
EACH TO HAVE:

6 EACH BUTTS        FBB199 4.5 X 4.5 NRP 630
1 EACH LOCKSET       45H7D16J  630
1 SET FLUSH BOLTS    555-12”  626
1 EACH CLOSER        D4550CS S/N 689 (ACTIVE LEAF)
1 EACH THRESHOLD     271A
2 EACH DOOR SHOES    216AV
1 SET WEATHERSTRIPING 303AS
3 EACH SILENCERS     608

SET #9
DOORS 200A, 502B

3 EACH HINGES        FBB 199 4.5 X 4.5 NRP 630
1 EACH LOCKSET       45H7D16J  630
1 EACH CLOSER        D4550CS X S/N X 689
1 EACH KICKPLATE     10”X 2” LTDW X 630
1 EACH THRESHOLD     158A (271A @ DR. 200A)
1 EACH DOOR SHOE     216AV
1 SET WEATHERSTRIPING 303AS
3 EACH SILENCERS     608
SECTION 08800 - GLAZING

PART 1 GENERAL

1.1  SUMMARY

   A. Section Includes: Glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

   1. Windows.
   2. Doors.

   B. Related Sections:

   1. Division 8 Section "Steel Doors and Frames": Glazed hollow metal construction.
   2. Division 8 Section "Aluminum Windows": Glazed aluminum windows.
   3. Division 8 Section "Steel Doors": Glazed steel doors.
   4. Division 8 Section "Automatic Entrance Doors": Glazed automatic doors.
   5. Division 8 Section "Unit Skylights": Factory glazed plastic unit skylights.
   6. Division 10 Section "Toilet Accessories": Glass in framed mirrors.

1.2  DEFINITIONS

   A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

   B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

   C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

   D. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

   E. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.3  PERFORMANCE REQUIREMENTS

   A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

   B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

      1) Basic Wind Speed: 90 mph.
      2) Importance Factor: 1.0.
      3) Exposure Category: B.

   b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action; load duration 60 seconds or less.

   c. Maximum Lateral Deflection: For glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

   d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

   A. Product Data: For each glass product and glazing material indicated.

   B. Qualification Data: For installers.

   C. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

   A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.

   B. Source Limitations for Glass: Obtain each type of glass through one source from a single manufacturer.

   C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

   D. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.

      1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

      2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or
II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.


F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

1.6 PRODUCT HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 5 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; class indicated.
B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Laminated Glass, General: ASTM C 1172, and complying with other requirements specified and with the following:

1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
   a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

D. Laminated-Glass Units:

1. Kind LA, consisting of two lites of annealed float glass.
2. Outer Lite: Class 1 (clear) float glass; 3.0 mm thick.
3. Plastic Interlayer:
   a. Thickness: 0.030 inch, but not less than that required to comply as a Type II safety glass material.
   b. Interlayer Color: Clear.
4. Inner Lite: Class 1 (clear) float glass; 3.0 mm thick.

E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
5. Spacer Specifications: Manufacturer's standard spacer material.

2.2 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.4 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2  PREPARATION
   A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3  GLAZING, GENERAL
   A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

   B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

   C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

   D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

   E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

   F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

   G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

      1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

      2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

   H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

   I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4  SEALANT GLAZING (WET)
   A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

   B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

   C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 GLAZING APPLICATION SCHEDULE

A. General: Provide the types of glass specified in this Article for the applications indicated and complying with Part 2 Articles for glazing types.

B. Safety Glass: Provide fully tempered units where indicated on Drawings, where specified or where required to fulfill performance criteria, unless another type of safety glazing is indicated.

C. Aluminum Windows: 1” thick insulating unit, clear glass with low-e coating.

D. Automatic Entrance Doors: Insulating unit of manufacturer's standard thickness, clear tempered glass.
SECTION 09111 - NON-LOAD-BEARING STEEL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Non-load-bearing steel framing members for interior framing systems, including supports for partition walls, furring, and similar conditions.

B. Related Sections:
   1. Division 9 Section "Gypsum Board": Gypsum panels supported by non-load-bearing steel framing.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0312 inch (20 gage).
   2. Depth: 3-5/8 inches, unless otherwise indicated.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: 0.0312 inch.

C. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches, unless otherwise indicated.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base Metal Thickness: 0.0179 inch, unless otherwise indicated.
   2. Depth: 7/8 inch, unless otherwise indicated.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
B. Isolation Strip at Exterior Walls: Foam gasket; adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION
3.1 EXAMINATION
A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL
A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES
A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb, unless otherwise indicated.

   b. Where one-piece control joints are indicated or required at door heads, install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY
A. Section Includes: Exterior portland cement plasterwork (stucco) on metal lath over unit masonry.

1.2 QUALITY ASSURANCE
A. Mock-ups: Before plastering, install mock-ups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.

1.4 PRODUCT HANDLING
A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 PROJECT CONDITIONS
A. Comply with ASTM C 926 requirements.
B. Exterior Plasterwork:
   1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
   2. Apply plaster when ambient temperature is greater than 40 deg F.
   3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
C. Factory-Prepared Finishes: Comply with manufacturer’s written recommendations for environmental conditions for applying finishes.

PART 2 PRODUCTS

2.1 METAL LATH
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
      b. CEMCO.
      c. Clark Western Building Systems.
      d. Dietrich Metal Framing; a Worthington Industries company.

B. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper.
   1. Provide paper-backed lath unless otherwise indicated.

2.2 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
      b. CEMCO.
      c. Clark Western Building Systems.
      d. Dietrich Metal Framing; a Worthington Industries company.
      e. MarinoWARE.
      f. Phillips Manufacturing Co.
      a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
      b. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.
   5. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.
   6. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

2.3 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.

C. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.

2.4 PLASTER MATERIALS

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

B. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

D. Engineered Base Coat: Manufacturer's standard premixed, factory-blended stucco mixture of Portland cement, reinforcing fibers, sand, and proprietary ingredients; recommended by manufacturer for scratch and brown coats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Senergy, BASF Wall Systems, Inc.; SENERGY STUCCOBASE.

E. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over Portland cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Senergy, BASF Wall Systems, Inc.; SENERFLEX.
2. Color: As selected by Architect from manufacturer's full range.
3. BASF Wall System's AnticoGlaze™: 100% acrylic-based stain or glaze which produces varied degrees of mottling, coloration and glaze, based upon the combination of application technique, the color of the AnticoGlaze™ itself and the color of the finish it is applied to; color by Architect.

2.5 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:
   a. Scratch Coat: For cementitious material, mix 1 part Portland cement and 0 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
   b. Brown Coat: For cementitious material, mix 1 part Portland cement and 0 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Factory-Prepared Finish-Coat Mixes: For acrylic-based finish coatings, comply with manufacturer's written instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.
3.3 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

3.4 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners: Install cornerbead.

C. Control Joints: Install control joints in specific locations approved by Architect for visual effect as follows:
   1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
      a. Vertical Surfaces: 144 sq. ft.
      b. Horizontal and other Nonvertical Surfaces: 100 sq. ft.
   2. At distances between control joints of not greater than 18 feet o.c.
   3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
   4. Where control joints occur in surface of construction directly behind plaster.
   5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 PLASTER APPLICATION

A. General: Comply with ASTM C 926.
   1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.
   2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
   3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Walls: Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork, 3/4-inch thickness.
   1. Portland cement mixes.

C. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
   1. Finish Texture: Produce smooth (sponge) texture as approved by Architect.

3.6 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.
3.7 PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION
SECTION 09250 - GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.
   3. Fire rated gypsum board.

B. Related Sections:
   1. Division 9 Section "Non-Load-Bearing Steel Framing": Non-structural framing systems that support gypsum board.
   2. Division 9 Section "Paints and Coatings": Primers applied to gypsum board surfaces.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For trim accessories; full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
2.2 PANELS, GENERAL
   A. Size: Provide in maximum lengths and widths available that will minimize joints in each area
   and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD
   A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of
   gypsum board indicated and whichever is more stringent.
   B. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. G-P Gypsum; DensArmor Interior Guard.
         b. USG Corporation; FIBEROCK Brand, Aqua Tough Interior Panels.
      2. Core: 5/8 inch, Type X.
      4. Provide fire-rated where indicated on drawings.

2.4 TILE BACKING PANELS
   A. Gypsum-Core, Water-Resistant Backing Board: ASTM C 1178/C 1178M.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. G-P Gypsum; DensShield Tile Guard.
         b. USG Corporation; FIBEROCK Brand, Aqua Tough Tile Backerboard.
      2. Core: 5/8 inch.

2.5 SHAFTWALL PANELS
   A. Gypsum-Core, 1" shaft line panel
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. USG Corporation; SHEETROCK Brand Gypsum Liner Panels

2.6 TRIM ACCESSORIES
   A. Interior Trim: ASTM C 1047.
      1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced
         galvanized steel sheet.
      2. Shapes:
         a. Cornerbead.
         b. LC-Bead: J-shaped; exposed long flange receives joint compound.
         c. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS
   A. General: Comply with ASTM C 475/C 475M.
   B. Joint Tape: Us type recommended by panel manufacturer.
C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels: As recommended by backing panel manufacturer.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

C. Locate edge and end joints over supports. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Form control and expansion joints with space between edges of adjoining gypsum panels.
E. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Panel Type: Install moisture- and mold-resistant type for vertical and horizontal surfaces, unless otherwise indicated.

B. Single-Layer Application: Apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

1. Stagger abutting end joints not less than one framing member in alternate courses of panels.
2. At stairwells and similar high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile unless otherwise indicated.

B. Gypsum-Core, Water-Resistant Backing Board: Install at tile backsplashes and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. U-Bead: Do not use.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: At panel surfaces located in enclosed closets and storage rooms.
   4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated, and at panel surfaces serving as substrate for wall coverings.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

F. Gypsum-Core, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
SECTION 09310 - CERAMIC TILE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ceramic tile.
   2. Stone thresholds.

B. Related Sections:
   1. Division 3 Section "Cast-in-Place Concrete": concrete floors.
   2. Division 7 Section "Joint Sealants": Sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   3. Division 9 Section "Gypsum Board": Tile backer board.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


1.3 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
   2. Full-size units of each type of trim and accessory for each color and finish required.

D. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Mock-ups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mock-up of floor tile installation.
   2. Build mock-up of wall tile installation.
   3. Approved mock-ups may become part of the completed Work if undistributed at time of Substantial Completion.

1.6 PRODUCT HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store liquid materials in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Floor Tile: Unglazed porcelain tile.
   1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide St. Germain ColorBody Porcelain Tile by American Olean.
   2. Composition: Porcelain.
   3. Face Size: 6 by 24 inches.
   5. Tile Color and Pattern: As selected by Architect from manufacturer's full range or as indicated on drawings.
   6. Grout Color: As selected by Architect from manufacturer's full range.
   7. Surface Texture: Non-slip.
B. Floor Tile: Unglazed quarry tile.
   1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide Quarry Tile by American Olean
   2. Composition: Ceramic.
   3. Face Size: 4 by 8 inches.
   4. Thickness: 1/2 inch.
   5. Tile Pattern: Basketweave by American Olean
   6. Tile Color: As selected by Architect from manufacturer's full range.
   7. Grout Color: As selected by Architect from manufacturer's full range.

C. Wall Tile: Glazed wall field tile.
   1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide matte wall tile by American Olean, Color groups 1 & 2
   2. Composition: Ceramic.
   3. Face Size: 6 by 6 inches.
   5. Tile Color and Pattern: Matte finish. Colors and patterns as selected by Architect from manufacturer's full range or as indicated on drawings.
   6. Grout Color: As selected by Architect from manufacturer's full range.
   7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes, as indicated on drawings:
      a. Base: Cove, module size 6 by 6 inches.
      b. External Corners: Surface bullnose, same size as adjoining flat tile.
      c. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
      d. Trim pieces: Catarina 1/2 inch by 6 inch wall border. Use as indicated on drawings.

D. Wall Tile: Unglazed wall mosaic tile.
   1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide unglazed Mosaics/Options by American Olean, Color groups 2 & 3
   2. Composition: Ceramic.
   3. Face Size: 2 inch Octagon.  
      Face Size: 1 inch Dot.
   4. Thickness: 1/4 inch.
   5. Tile Color and Pattern: As selected by Architect from manufacturer's full range or as indicated on drawings.
   6. Grout Color: As selected by Architect from manufacturer's full range.
   7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes, as indicated on drawings:
      a. Base: Cove, module size 6 by 6 inches.
      b. External Corners: Surface bullnose, same size as adjoining flat tile.
      c. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS
A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 SETTING MATERIALS


1. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
2. Latex Additive: Manufacturer’s standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American; an Oldcastle company.
   b. Bostik, Inc.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Mer-Kote Products, Inc.
   f. Summitville Tiles, Inc.
   g. TEC; a subsidiary of H. B. Fuller Company.

2. Provide one of the following, as standard with manufacturer:
   a. Prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   b. Prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American; an Oldcastle company.
   b. Bostik, Inc.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Summitville Tiles, Inc.
   f. TEC; a subsidiary of H. B. Fuller Company.

2. Polymer Type: One of the following, as standard with manufacturer:
a. Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
b. Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Tile Sealer: Basis-of-Design Product: Miracle Sealants Co (1 800 350-1901) 511 Impregnator.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bonsal American; an Oldcastle company; Grout Sealer.
   b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
   c. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
   d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
   f. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Floor Tile: 1/4 inch.
2. Glazed Wall Tile: 1/16 inch.

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section “Joint Sealants.”

G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).

H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer’s written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

I. Tile Sealer: Install per tile sealeant manufacturer’s written instructions.

3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer’s written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and ANSI A108.1C.

   a. Tile Type: Quarry tile or porcelain tile as indicated.
   c. Grout: Polymer-modified sanded grout.

B. Interior Wall Installations, Metal Studs or Furring:

1. Tile Installation W245: Thin-set mortar on coated glass-mat, water-resistant gypsum backer board; TCA W245.

   a. Tile Type: Glazed ceramic and unglazed mosaic as indicated.
   b. Thin-Set Mortar: Latex-portland cement mortar.
   c. Grout: Polymer-modified unsanded grout.
SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Acoustical panels and exposed suspension systems for ceilings.

B. Related Sections:
   1. Division 15 Sections: Sprinkler heads, grilles, registers, diffusers and other ceiling-mounted mechanical items.
   2. Division 16 Sections: Lighting fixtures, smoke detectors, and other ceiling-mounted electrical items.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension members.
   2. Method of attaching hangers to building structure.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
   1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
      a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
2. CISCA’s Recommendations for Acoustical Ceilings: Comply with CISCA’s “Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2.”

1.4 PRODUCT HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.6 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer’s standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers’ proprietary product designations, provide products selected by Architect from each manufacturer’s full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 MINERAL-BASE ACOUSTICAL PANELS
A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. BPB Celotex Corporation.
3. USG Interiors, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with washable vinyl-film overlay.

C. Panel Characteristics:

2. LR: Not less than 0.85.
3. Edge Detail: Square.
5. Size: 24 by 24 inches.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

E. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

I. Hold-down Clips: Manufacturers standard hold down clips.
2.4 METAL SUSPENSION SYSTEM

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. BPB Celotex Corporation.
   3. Chicago Metallic Corporation.
   4. USG Interiors, Inc.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.
   2. End Condition of Cross Runners: Butt-edge type.
   3. Face Design: Flat, flush.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
   1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION
SECTION 09666 - RESILIENT SHEET FLOORING

1. GENERAL

1.1 SUMMARY

A. Provide and install commercial resilient vinyl flooring per manufacturer’s installation requirements and recommendations.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer’s product data and installation instructions for watertight application.

B. Samples: Submit representative sample of each material specified, indicating visual characteristics and finish

1.3 QUALITY ASSURANCE

A. Contractor will assure compliance with 2.3 Job Conditions to allow for proper installation.

B. Comply with local governing codes and regulations.

C. Use PROTECT-ALL factory trained installers that are approved or recommended by manufacturer.

D. Manufacturer provides a limited 10 year product warranty against manufacturing defects. Warranty does not in any way cover installation-related issues.

2. PRODUCTS

2.1 PRE-APPROVED PRODUCTS


1. PROTECT-ALL Commercial Flooring. Sheets 5' x 5' or 5' x 8' (¼" thicknesses), in color chosen from manufacturer's samples in matte finish.

2. PROTECT-ALL Flooring Adhesives.

3. PROTECT-ALL Cove Base and Corners must be a minimum of 6" high.

4. PROTECT-ALL V-Rod Welding Rod

5. PROTECT-ALL Aluminum/PVC Cove Base Cap

6. Stainless Steel drain rings as provided by Oscoda Plastics.

7. Oscoda Plastics sealants and adhesives.

8. Other installation materials as required and supplied by Oscoda Plastics, Inc.

2.2 PRE-APPROVAL OF SUBSTITUTE MATERIALS, SYSTEMS or INSTALLERS

A. Submit to the architect for approval any product or system not specified or listed as pre-approved herein and in compliance with instructions to bidder's request for substitutions.

B. Provide manufacturer documentation to support results of the following test standards:

   1. ASTM G-21 Bacteria & Mildew Resistance Excellent
   2. ASTM D-751 Breaking Strength (md) 405lbs
   3. ASTM D-751 Breaking Strength (cmd) 723lbs
4. ASTM D-2047 Coefficient of Friction (avg) Dry 0.88
5. ASTM D-695 Compressive Strength @ 20% Deformation 641 psi
6. ASTM D-751 Elongation (md) 76.5%
7. ASTM D-751 Elongation (cmd) 88.5%
8. ASTM E-648 Critical Radiant Flux 1.05W/cm² - Type 1 NFPA fire classification
9. ASTM E-648 Burn Distance 12 cm
10. Shore A Hardness 80-85 avg
11. ASTM D-751 Tear Strength (md) 76.5lbs
12. ASTM D-751 Tear Strength (cmd) 84lbs
13. NFSI UWT-101A Coefficient of Friction Standard >0.06

C. Manufacturer installation instructions for watertight applications along with required accessories.
D. Experience of installer pertaining to heat-welding PROTECT-ALL Commercial Flooring and list of factory trained installers.
E. Provide representative samples of product depicting color and finished surface of installed flooring material. Include range samples, if variation of finish is anticipated.
F. Provide a mock-up showing cove base, corner, and drain details with welding example.
G. Provide documentation attesting to the successful use of product in wet areas.
H. Provide copy of manufacturer’s 10-year product warranty.

2.3 VERIFICATION OF JOB CONDITIONS

A. Proper Substrate
   1. Assure that the substrate material is suitable for installation of flooring as indicated by manufacturer. Approved substrates include: marine-grade wood, cement board, and concrete (non-gypsum based only), properly cleaned and prepared per manufacturer’s guidelines.
   2. Slab substrates must be dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by floor covering manufacturer.
   3. Verify a clean, dry, and structurally sound surface to accept adhesive, free of cracks, ridges, depression, scales, and foreign deposits of any kind.
   4. Use only cementitious patching and filling compounds (3000 PSI). Consult manufacturer for details. (ACI 302.2R-06 ch. 9.5)
   5. Assure that the levelness (Fₐ₁₅), and flatness (F₂₀ 5/16 in 10 Ft.) of surface is in compliance with manufacturer’s guidelines.
   6. Verify that sub-floor surfaces (concrete, marine-grade plywood, cement board) are ready for resilient flooring installation by testing moisture emission rate and alkalinity, in accordance with ASTM F 710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer. Reference ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   7. The following standards apply:
      • ASTM E 1745-97 – Standard Specification for Water Vapor Retarders
      • ASTM E 1643 – Standard Practice for Installation of Water Vapor Retarders used in contact with Earth or Granular Fill Under Concrete Slabs
      • ASTM E 96-00 – Standard Test Method for Water Vapor Transmission of Materials
      • ACI 302.1R-04 – Guide for Floor and Concrete Slab Construction
      • ACI 302.2R-06 – Guide for Concrete Slabs That Receive Moisture-Sensitive Flooring Materials
• ASTM F710-08 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
• ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

B. Environmental Conditions

1. The contractor and installer of product is responsible for providing and maintaining a proper installation environment.
2. Installation area must be enclosed and watertight with all walls, wall finishes, doors, and floor penetrations in place.
3. Proper temperature acclimation of flooring material is required prior to installation. Minimum of 36-hours.
4. Assure confinement of space during installation and curing of adhesives to prevent other trades from damaging the product or compromising the adhesion.
5. Maintain a constant temperature during the installation and throughout the curing of adhesives.
6. Provide a secure area to store materials for installation.
7. Building must be completely enclosed and water-tight. A/C must be on at least 7 days prior to installation beginning, keeping the interior temperature at 70º. This temperature should be maintained during the installation, and an additional 8 days after completion.

C. Proper Drain and Other Floor Penetration Elevations

1. All drains to be installed level and with proper slope, no more than ¼" above surface of subfloor.
2. When “dishing” of drain area is specified, the “dish” should not be less than 12" in diameter and more than 1" in depth.
3. All other penetrations should be installed no more than ¼" above surface and provide accommodation for proper sealing.
4. Penetrations not terminating at floor surface must be a minimum of 6" above the surface of floor and be installed in such a way as to not interfere with the installation of the flooring or the base material, and allow adequate space for sealant to be applied to the entire perimeter, and finished off with manufacturer specified detail.

3. EXECUTION

3.1 INSTALLATION

A. Follow manufacturer recommendations for laying sheets out.
B. Flooring must be cut tight to all penetrations.
C. Adhere the floor material using manufacturer’s recommended adhesive for the particular substrate type, job conditions, and in compliance with spread rate and proper trowel size.
D. Roll floor into adhesive with 100# roller per manufacturer directions.
E. Install stainless steel drain rings around all drains and other surface penetrations. Rings are to be routed into floor surface and mounted flush with top of flooring. Secure drain rings using stainless steel fasteners and lead anchors that will properly anchor the ring to the substrate.
F. Install cove base as recommended by manufacturer with proper adhesive and top sealant. Heat-weld all seams.
G. Install cove base cap fastening to wall a minimum of 8" on-center using non-corrosive fasteners.
H. Heat-weld all field material seams using manufacturer’s welding rod, proper tools, and installation methods as approved by manufacturer.

I. Stainless steel transitions as provided by the manufacturer must be used in doorways, and will be routed flush with surface of the sheet and fastened 6" on-center, using stainless steel fasteners, and lead anchors.

J. All exposed edges are to be sealed with manufacturer’s recommended sealant to assure a watertight seal.

3.2 CLEANING

A. Sweep-clean the floor after installation and clear area of scrap materials. The floor can be saturated and then deck brushed, power washed, or power scrubbed to remove construction debris. Installer must provide two copies of manufacturer’s cleaning recommendations for contractor and owner use. Openings on site to verify installation of hardware is complete and properly adjusted. Compensate for final operation of heating and ventilating equipment.
1.1 SUMMARY

A. Section Includes: Surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.
2. Exposed interior items and surfaces.
3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment located in public spaces.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:
   a. Architectural casework.
   b. Toilet compartments.
   c. Finished mechanical and electrical equipment.
   d. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces (Note that Restroom utility chase (514) is not considered concealed):
   a. Foundation spaces.
   b. Furred areas.
   c. Ceiling plenums.
   d. Pipe spaces.
   e. Duct shafts.

3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections:

1. Division 5 Section "Structural Steel": Shop priming structural steel.
2. Division 5 Section "Metal Fabrications": Shop priming ferrous metal.
3. Division 8 Section "Steel Doors and Frames": Shop priming steel doors and frames.
4. Division 9 Section "Gypsum Board": Surface preparation for gypsum board.

1.2 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.4 PRODUCT HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.
B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.5 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

D. Provide adequate ventilation, including mechanical ventilation, to remove paint odors and fumes from areas of the building where odors might migrate to occupied spaces.

1.6 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to area designated by Owner.

1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules, or comparable products of another approved manufacturer.

B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:


2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

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B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

D. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
E. Colors: Provide color selections made by the Architect from manufacturer's full range of available colors. Where directed, provide custom colors of the finished paint systems to match the Architect's samples.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete and masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
c. When transparent finish is required, backprime with spar varnish.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Surface treatments and finishes are indicated in the schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Piping, pipe hangers, and supports.
2. Tanks.
3. Ductwork.
4. Insulation.
5. Supports.
6. Motors and mechanical equipment.
7. Accessory items.

G. Electrical items to be painted include, but are not limited to, the following:

1. Conduit and fittings.
2. Panelboards.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
1. Provide a smooth, uniform finish, appearance, and coverage. Spotting, laps, roller marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:

   a. Quantitative material analysis.
   b. Abrasion resistance.
   c. Apparent reflectivity.
   d. Flexibility.
   e. Washability.
   f. Absorption.
   g. Accelerated weathering.
   h. Dry opacity.
   i. Accelerated yellowness.
   j. Recoating.
   k. Skinning.
   l. Color retention.
   m. Alkali and mildew resistance.

3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.5 CLEANING AND PROTECTION
A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT AND COATING SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.

1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Concrete Walls Indicated to Receive Stain:

1. Acid Stain Concrete:
   d. Provide 4’ x 4’ Mock-up panel for approval by Architect.
   e. Apply per manufacturer’s recommendation.

C. Painted Exterior Wood Trim:

1. Semigloss, Acrylic-Enamel Finish:
   a. Primer: Benjamin Moore & Co; Super Spec Primer #176; 1.6 mils DFT.
   b. First Coat: Benjamin Moore & Co; MoorGlo Latex House & Trim Paint #096; 2.4 mils DFT.
   c. Second Coat: Benjamin Moore & Co; MoorGlo Latex House & Trim Paint #096; 2.4 mils DFT.

D. Exterior Plywood Soffits:

1. Flat Acrylic Finish:
   a. Primer: Benjamin Moore & Co; Super Spec Primer #176; 1.6 mils DFT.
   b. First Coat: Benjamin Moore & Co; Super Spec Latex House Paint #170; 2.2 mils DFT.
   c. Second Coat: Benjamin Moore & Co; Super Spec Latex House Paint #170; 2.2 mils DFT.
E. Stained Exterior Wood Trim and Log Siding:
   1. Flat Alkyd Semi Transparent Stain Finish:
      a. First Coat: Benjamin Moore & Co; Alkyd Semi Solid Stain # 329/C329
      b. Second Coat: Benjamin Moore & Co; Alkyd Semi Solid Stain # 329/C329

F. Stained Exterior Cedar:
   1. Flat Alkyd Transparent Stain Finish:
      a. First Coat: Benjamin Moore & Co; Transparent Stain #323/C323
      b. Second Coat: Benjamin Moore & Co.; Transparent Stain #323/C323

G. Exterior Ferrous Metal:
   1. Gloss, Alkyd-Enamel Finish:
      a. Primer: Benjamin Moore & Co. Alkyd Metal Primer #P06; 2.0 mils DFT.
      b. First Coat: Benjamin Moore & Co. Urethane Alkyd Gloss Enamel; 2.0 mils DFT.
      c. Second Coat: Benjamin Moore & Co. Urethane Alkyd Gloss Enamel; 2.0 mils DFT.

H. Exterior Pre-Primed Metal:
   1. Gloss, Enamel Finish:
      a. First Coat Benjamin Moore & Co. # P20 Rapid Dry Gloss Enamel
      b. Second Coat Benjamin Moore & Co. # P20 Rapid Dry Gloss Enamel

I. Exterior Zinc-Coated Metal:
   1. Gloss, Acrylic Urethane Finish:
      a. Pretreatment Surface Preparation: As recommended by coating manufacturer including light abrasion.
      b. Primer: Moore; Polyamide Epoxy Metal Primer # P33; 2.0 mils DFT.
      c. First Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.
      d. Second Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.

J. Exterior Zinc-Coated Metal – Animal Barriers:
   1. Gloss, Acrylic Urethane Finish:
      a. Pretreatment Surface Preparation: As recommended by coating manufacturer including light abrasion.
      b. Primer: Moore; Polyamide Epoxy Metal Primer # P33; 2.0 mils DFT.
      c. First Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.
      d. Second Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.

K. Exterior Ground Faced CMU:
   1. Clear Sealer:
      a. First Coat: Benjamin Moore & Co. # P41 Fast Dry Epoxy Sealer
      b. Second Coat: Benjamin Moore & Co # P41 Fast Dry Epoxy Sealer
3.7 INTERIOR PAINT AND COATING SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.

1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Interior Concrete Floors:

1. Clear Sealer:
   a. First Coat: Benjamin Moore & Co. # P41 Fast Dry Epoxy Sealer
   b. Second Coat: Benjamin Moore & Co # P41 Fast Dry Epoxy Sealer

C. Interior Concrete Walls:

1. Acrylic Latex Opaque Concrete Stain:
   a. First Coat: Benjamin Moore & Co; #072 Acrylic Latex Opaque Concrete Stain
   b. Second Coat: Benjamin Moore & Co; #072 Acrylic Latex Opaque Concrete Stain

D. Interior Ground Face Concrete Masonry Units (CMU):

1. Clear Sealer:
   a. First Coat: Benjamin Moore & Co. # P41 Fast Dry Epoxy Sealer
   b. Second Coat: Benjamin Moore & Co # P41 Fast Dry Epoxy Sealer

E. Gypsum Board Ceilings:

1. Flat Acrylic, Low-VOC Finish:
   a. Primer: Moore; Eco Spec Interior Latex Primer Sealer 372; 1.2 mils.
   b. First Coat: Moore; Eco Spec Interior Latex Flat # 373; 1.5 mils DFT.
   c. Second Coat: Moore; Eco Spec Interior Latex Flat # 373; 1.5 mils DFT.

F. Gypsum Board Walls, Typical Locations:

1. Low-Luster, Acrylic-Enamel, Low-VOC Finish:
   a. Primer: Moore; Eco Spec Interior Latex Primer Sealer # 372; 1.2 mil DFT.
   b. First Coat: Moore; Eco Spec Interior Latex Eggshell Enamel # 374; 1.4 mls DFT.
   c. Second Coat: Moore; Eco Spec Interior Latex Eggshell Enamel # 374; 1.4 mls DFT.

G. Gypsum Board, Moisture Conditions: Including kitchens, toilet rooms, and custodial closets.

1. Semigloss, Acrylic-Enamel, Low-VOC Finish:
   a. Primer: Moore; Eco Spec Interior Latex Primer Sealer # 372; 1.2 mil DFT.
   b. First Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376; 1.5 mls DFT.
   c. Second Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376 1.5 mls DFT.

H. Painted Interior Woodwork:
1. Semigloss, Acrylic-Enamel, Low-VOC Finish:
   a. Primer: Moore; Eco Spec Interior Latex Primer Sealer # 372; 1.2 mil DFT.
   b. First Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376; 1.5 mils DFT.
   c. Second Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376 1.5 mils DFT.

I. Stained Interior Woodwork: Including wood trim
   1. Alkyd-Based, Satin-Varnish Finish:
      a. Filler Coat: Moore; Benwood Paste Wood Filler #238; wipe wood filler before applying stain.
      b. Stain Coat: Moore; Benwood Penetrating Stain #234.
      c. Sealer Coat: Moore; Moore's Interior Wood Finishes Quick-Dry Sanding Sealer #413.
      d. First Finish Coat: Moore; Benwood Satin Finish Varnish #435.
      e. Second Finish Coat: Moore; Benwood Satin Finish Varnish #435.

J. Interior Ferrous Metal:
   1. Semigloss, Acrylic-Enamel, Low-VOC Finish:
      a. Primer: Moore; Eco Spec Interior Latex Primer Sealer # 372; 1.2 mil DFT.
      b. First Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376; 1.5 mils DFT.
      c. Second Coat: Moore; Eco Spec Interior Latex Semi Gloss; # 376 1.5 mils DFT.

K. Interior Zinc-Coated Metal:
   1. Gloss, Acrylic Urethane Finish:
      a. Pretreatment Surface Preparation: As recommended by coating manufacturer including light abrasion.
      b. Primer: Moore; Polyamide Epoxy Metal Primer # P33; 2.0 mils DFT.
      c. First Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.
      d. Second Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.

L. Interior Zinc Coated Metal – Animal Barriers:
   1. Gloss, Acrylic Urethane Finish:
      a. Pretreatment Surface Preparation: As recommended by coating manufacturer including light abrasion.
      b. Primer: Moore; Polyamide Epoxy Metal Primer # P33; 2.0 mils DFT.
      c. First Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.
      d. Second Coat: Moore; Aliphatic Acrylic Urethane (Gloss) # P74; 2.0 mils DFT.

END OF SECTION
SECTION 10155 - TOILET COMPARTMENTS

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes: Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:
   1. Division 6 Section "Rough Carpentry": Concealed blocking.
   2. Division 10 Section "Toilet Accessories": Toilet tissue dispensers, grab bars, and similar accessories.

1.2  SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of centerlines of toilet fixtures.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

E. Product Certificates: For each type of toilet compartment, from manufacturer.

F. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.3  QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.4  PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2  PRODUCTS

2.1  MATERIALS

A. Stainless-Steel Castings: ASTM A 743/A 743M.
2.2 SOLID-POLYMER UNITS

A. Basis-of-Design Product: The design for toilet compartments is based on The Mills Company, Subsidiary of Bradley Corp., 800-272-3539. Subject to compliance with requirements, provide products of the named manufacturer or comparable product by another approved manufacturer.


C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
   1. Composition: 100 percent post-consumer recycled polyethylene.
   2. Integral Hinges: Configure doors and pilasters to receive integral hinges.
   3. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
   4. Color and Pattern: One color and pattern in each room, unless otherwise indicated, as selected by Architect from manufacturer's full range.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.
   1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range.

F. Brackets (Fittings): Full-height (continuous) type; manufacturer's standard design; stainless steel.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
   3. Latch and Keeper: Manufacturer's standard latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
   4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
   6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION
SECTION 10240 - METAL WALL LOUVERS

1 GENERAL
1.01 Work Included
   A. Aluminum louvers and frames.
   B. Bird screening.
1.02 Work Installed But Furnished Under Other Sections
   A. Section 07920 - Joint Sealers: Perimeter sealants.
   B. Section 09900 – Painting: Paint system specified for Metal Louvers.
1.03 Work Furnished But Installed Under Other Sections
   A. Furnish head, jamb, and sill flashings to Section 07620 - Sheet Metal Flashing and Trim for installation.
1.04 Related Work
   A. Section 07920 - Joint Sealers.
   B. Div. 15 - Mechanical: Ductwork, operating devices, and other equipment used in conjunction with louvers.
   C. Div. 16 - Electrical: Power requirements for operating devices used in conjunction with louvers.
1.05 References
   C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.
1.06 System Performance
   A. Installed louver to permit passage of air velocity as identified in mechanical specifications.
1.07 Quality Assurance
   A. Manufacturer: Company specializing in manufacture of AMCA certified louvers with five years experience.
1.08 Submittals
   A. Submit shop drawings, product data, samples, and Manufacturer's installation instructions under provisions of Division 1.
   B. Shop Drawings: Indicate on shop drawings, layout, elevations, dimensions, and tolerances; head, jamb, and sill details; blade configuration; screening; and frames.
   C. Product Data: Provide product data on preassembled louvers describing design characteristics,
maximum recommended air velocity, free area, materials, and finishes.

D. Samples: Submit two samples 6 x 6 inch in size illustrating finish and color of exterior and interior pre-finish.

E. Installation Instructions: Submit manufacturer's installation instructions.

1.09 Coordination

A. Coordinate work of this Section with mechanical ductwork and electrical services to motorized devices.

2. PRODUCTS

2.01 Acceptable Manufacturers

A. Provide one-piece metal louver blades and frame, from the following manufacturer:
   2. Architect approved equal, subject to the technical requirements of this Section.

2.02 Materials

A. Aluminum: ANSI/ASTM B221, 6063-T52 alloy, .81 inch thick; extruded shape, pre-finished with mill applied fluorocarbon, paint finish.

B. Fasteners and Anchors: Stainless steel type.

2.03 Accessories

A. Bird Screen: Interwoven wire mesh of aluminum, 0.063 inch diameter wire 1/2 inch open weave, square design.

B. Primer: Zinc chromate, alkyd type.

C. Bituminous Paint: SSPC - Paint 12 (Cold-applied Asphalt Mastic).

D. Flashings: Of same material as louver frame.

E. Sealants: Type specified in Section 07920.

2.04 Fabrication

A. Fabricate grilles and enclosures to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. Preassemble grilles and enclosures in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinate installation.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide sill extensions and loose sills made of same material as grilles and enclosures, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.
F. Grille and enclosure assemblies shall be assembled entirely by welding. Vertical and horizontal bars shall be joined with fillet welds each (1) inch long x 0.125" throat and produced with the Pulsed Gas Metal Arc Welding Process (GMAW/MIG).

G. Louver Size: 4 inches deep or as indicated on the Drawings; face measurements as indicated in the Drawings.

H. Louver Blade: Sloped at 45 degree; minimum material thickness of 0.081 inch, dual waterstops on blade.

I. Louver Frame: Channel shape, welded corner joints, material thickness of 0.081 inch.

J. Mullions: Exposed of aluminum, profiled to suit louver frame.

K. Head, Jamb, and Sill Flashings: Roll formed to required shape, one piece per location.

2.05 Finishes

A. Comply with NAAMM Metal Finishes Manual for recommendations relative to application and designations of finishes.

B. Finish: Baked-on Primer (Factory-applied).

C. Field Finish: Custom patterned paint finish, per direction of the Architect.

3. EXECUTION

3.01 Inspection

A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that proper power supply is available.

C. Beginning of installation means acceptance of existing conditions.

3.02 Installation

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb, in proper alignment with adjoining work.

C. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

D. Form closely fitted joints with exposed connections accurately located and secured.

E. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

F. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.
G. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

H. Install screening to interior of louver. Hinge screens for access.

I. Install insect screens to intake exhaust louver. Install bird screens to exhaust intake louver.

J. Install perimeter sealant and backing rod in accordance with Section 07920.

3.03 Adjusting And Cleaning

A. Adjust operable louvers for freedom of movement; with actual control; lubricate operating joints.

B. Clean surfaces and components.

C. Protect aluminum surfaces from erosion when in contact with dissimilar metals or concrete by coating contact surfaces with zinc chromate primer or bituminous paint.

D. Repair any damaged finishes so that there is no evidence of corrective work.
SECTION 10810 - TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Providing public-use washroom accessories including the following:

1. Framed mirrors.
2. Grab bars.
3. Diaper-changing stations.

B. Owner-Furnished Material: Install toilet accessories furnished by Owner, including the following:

1. Surface-mounted toilet tissue holders.
2. Surface-mounted napkin/tampon disposals.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work
   and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each
   accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products
   of same manufacturer unless otherwise approved by Architect.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required
   for access by people with disabilities, and for proper installation, adjustment, operation, cleaning,
   and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent
   delaying the Work.

1.5 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace
   mirrors that develop visible silver spoilage defects and that fail in materials or workmanship
   within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.
PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.


E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.


2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.

B. Grab Bar:

3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.

C. Mirror Unit:

1. Basis-of-Design Product: Bobrick; B-165 Series.
2. Frame: Stainless-steel channel.
   a. Corners: Mitered and mechanically interlocked.
   a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Size: As indicated on drawings.
D. Diaper-Changing Station:

2. Description: Fabricate changing station from Terreon Lav Deck. Provide side splash all sides. Provide apron at front and exposed site.
   a. Engineered to support a minimum of 250-lb static load.
3. Mounting: Mounting brackets with Terreon strip at 24” o.c. min., TBRK2T

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION
SECTION 11162 - LOADING DOCK BUMPERS

PART 1 GENERAL

1.1 SUMMARY
A. Section Includes: Dock bumpers.

1.2 SUBMITTALS
A. Product Data: For dock bumpers. Include construction details and material descriptions.
B. Shop Drawings: For dock bumpers. Include plans, elevations, sections, details, and attachments to other work.

PART 2 PRODUCTS

2.1 DOCK BUMPERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Floor Products Company, Inc.
   2. Durable Corporation.
   3. Pawling Corporation; Architectural Products Division.

B. Laminated-Tread Dock Bumper: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch-thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch of tread plies extending beyond the face of closure angles.
   1. Thickness: 6 inches.
   2. Horizontal Style: 12 inches high by length indicated on Drawings.

C. Anchorage Devices: Stainless-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated.

PART 3 EXECUTION

3.1 INSTALLATION
A. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
   1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
SECTION 13121 – PRE-ENGINEERED BUILDINGS

PART 1 GENERAL

1.1 SECTION INCLUDES: Prefabricated metal shelter/gazebo/pavilion.

1.2 RELATED SECTIONS

A. Cast-In-Place Concrete, Section 03300.

1.3 REFERENCES

A. American Institute of Steel Construction (AISC)
B. American Iron and Steel Institute (AISI) Specifications for Cold Formed Members.
C. American Society of Testing of Materials (ASTM)
D. American Society for Quality (ASQ)
E. American Welding Society (AWS)
F. International Building Code (IBC)
G. Leadership in Energy and Environmental Design (LEED)
H. Lightning Protection Institute (LPI)
I. National Fire Protection Association (NFPA)
J. OSHA Steel Erection Standard 29 CFR 1926 Subpart R-Steel Erection
K. Steel Structures Painting Council (SSPC) SSPC-SP10 Near White Blast Cleaning

1.4 SYSTEM DESCRIPTION

A. PRODUCT DESIGN LOADS: IBC (2003 edition) 5 pounds per square foot roof snow load, 100 mile per hour basic wind speed, exposure B, seismic zone B, soil site class C.

B. DESIGN METHOD: Per applicable building code. Note: Manufacturer to use three-dimensional structural analysis to determine member load and forces.

C. The pre-engineered package shall be a pre-cut and pre-fabricated package that shall include powder coated structural frame members, roof material, fasteners, and trim as well as the installation instructions. The structure shall be shipped knocked down for minimum shipping charges. Field labor will be kept to a minimum by pre-manufactured parts. No onsite welding will be permitted. Connection bolts shall be concealed within the tubing where possible.

D. Where possible, tube column to concrete base will be surface mounted with all anchor bolts hidden within the column.

E. Where possible, the structure will have a moment connection at the top of the column and a pinned connection at the base of the column to ensure a clean connection at the base, reduce the size of the concrete base, and provide for one-step concrete installation process.

1.5 SUBMITTALS

A. Submit 4 sets shop drawings and 2 sets structural calculations signed and sealed by a Professional Engineer licensed in the State of Alabama.

B. Structural calculations shall be in conformance to item 1.5A under System Description.

1.6 QUALITY ASSURANCE: Provide evidence of commitment of quality craftsmanship as demonstrated by the following:

A. SUPPLIER QUALIFICATIONS:
1. The product shall be designed, produced, and finished at a facility owned and directly supervised by the supplier who has at a minimum of ten years under same ownership making steel frame pre-manufactured shelters. Cumulative experience in fabrication will not be an acceptable alternative.

2. The product shall be shipped from a single source.

3. Membership in American Institute of Steel Construction.


8. Full time on-staff Licensed Engineer.

9. Full time on-staff Quality Assurance Manager.

10. Published Quality Management System.

11. Full time on-staff AWS Certified Welding Inspector.

12. Continued certification by an independent inspection agency.

13. Control of finishing quality by in-house shot blast, pretreatment, primer and powder coating.

B. CERTIFICATIONS

1. City of Los Angeles (California) approved fabricator.
2. City of Houston (Texas) approved fabricator.
3. City of Riverside (California) approved fabricator.
4. City of San Bernardino (California) approved fabricator.
5. County of Clark County (Nevada) approved fabricator.
7. Welders Certified to AWS D1.1.
8. AWS Certified Welding Inspector.
9. ASQ Certified Quality Manager/Organizational Excellence

1.7 DELIVERY AND STORAGE: Installer shall unload materials with necessary equipment (no hand unloading), store covered out of weather, and keep out of direct sun. Inspect parts within 48 hours of delivery, compare with manufacturer's bill of material, and report any missing or non-conforming parts to manufacturer within this time.

1.8 LIMITED WARRANTY: Supply manufacturer's standard 10 year limited warranty on frame and 10 year limited warranty on Poligon’s Poli-5000 paint system.

PART 2 PRODUCTS

2.1 MODEL NUMBER: PVA 66
Dimensional modifications of standard structure making it a Special are as follows:
Roof Pitch: 8:12.

2.2 ACCEPTABLE MANUFACTURER


B. Substitutions must be approved a minimum of ten (10) days before bid. All approved manufacturers shall be notified in writing before the bid date and shall not be allowed to bid without written notification.

C. Alternate suppliers must meet the qualifications and provide proof of certifications listed under paragraph 1.7.
D. Alternate suppliers must provide equivalency to Poligon's Poli-5000 paint system.

E. Alternate suppliers must provide proof that their designs do not infringe on patents or copyrights.

2.3 MATERIALS

A. STRUCTURAL FRAMING: structural steel tube minimum ASTM A500 grade B, “I” beams; tapered columns, open channels, or wood products shall not be accepted for primary beams.

B. COMPRESSION RING: structural channel or welded plate minimum ASTM A36 or COMPRESSION TUBE: structural steel tube minimum ASTM A500 grade B.

C. STRUCTURAL FASTENERS: ASTM A325 high strength bolts and A563 high strength nuts, ASTM A307 anchor bolts.

D. ROOF DECK OF TONGUE AND GROOVE (T&G): T&G shall be of 2 x 6 tongue and groove, southern yellow pine, kiln dried #2 grade or better, edge V’d one side, fascia cut from 2 x 6 planks. Contractor shall seal underside of tongue and groove before installation per architect’s or owner’s recommendations using coating supplier’s instructions.

E. ROOFING TO BE SYNTHETIC THATCH ASSEMBLY per section #07312.

F. COLUMNS: K02 8” Square

G. ELECTRICAL ACCESS AND BOX CUTOUTS: Electrical access to be provided per manufacturer’s electrical access sheet. Electrical cut outs shall be marked as height above finish floor and size of cutout required.

H. LIGHTNING PROTECTION KIT: To be provided per section #16610 Lightening Protection System.

2.5 FABRICATION

A. All steel fabrication of tubes and plates shall be factory controlled under a documented Quality Management System. All parts shall be permanently etched with identification numbers. Fabrication facility will be experienced for a minimum of ten years in precision tube and plate fabrication. Cumulative experience in fabrication will not be an acceptable alternative.

B. Certified AWS welders, shall make all welded connections in accordance with AWS Specifications and trained by an AWS Certified Welding Inspector.

2.6 FINISHING STEEL

A. STANDARD POLI-5000 FINISH: For quality control purposes, steel shall be cleaned, pretreated and finished at a facility owned and directly supervised by the manufacturer. Steel shall be shot blasted to SSPC-SP10 near-white blast cleaning. SSPC-SP2 hand tool cleaning will not be an acceptable alternative. Parts shall be pretreated in a 3 stage iron phosphate or equal washer. Epoxy primer powder coat to be applied to parts for superior corrosion protection. Top powder coat of Super Durable TGIC Powder Coat to color selected from manufacturer’s standard color chart. For environmental purposes, finish shall allow no VOC emissions.

Sample production parts shall have been tested and meet the following criteria:
1. Salt spray resistance per ASTM B 117/ ASTM D 1654 to 5000 hours with no creep from scribe line and rating of 10.
2. Humidity resistance per ASTM D2247-02 to 3000 hours with no loss of adhesion or blistering.
3. Color/UV resistance per ASTM G154-04 to 2000 hours exposure, alternate cycles with results of a) no chalking b) 75% color retention c) Color variation maximum 3.0 E variation
PART 3 ERECTION

A. FOOTINGS: The shelter shall be set on prepared footings designed by structural engineer retained by owner using the column to footing reactions supplied by Poligon, anchor bolts to be provided by Poligon, and concrete slab (if required) provided by others. The contractor must use appropriate construction practices for the specific site conditions.

B. Install all components according to manufacturer's installation instructions and these specifications.

END OF SECTION
SECTION 13140 - ELECTRIC BARRIER FENCING

1. GENERAL

1.01 Section Includes

A. Electrified Fencing and Accessories.
B. Hot Grass System and Accessories.

1.02 Related Sections

A. Division 16 – Electrical: For all electrical requirements.

1.03 Regulatory Requirements

A. All electrical components shall comply with current electrical codes and all governing authorities.

1.04 Submittals

A. Submit Shop Drawings, Product Data under provisions of Section 01300.

B. Shop Drawings: Indicate on shop drawings locations of all components, component lists and installation details.
   1. Show electrical diagrams for all component parts.
   2. Coordinate all circuiting and power feeds for Work of this Section.

C. Product Data: Provide data indicating material characteristics, performance criteria, limitations, storage and maintenance data. Provide written information to Owner on performing maintenance at completion of project.

2. PRODUCTS

2.01 Electrified Barrier Fencing

A. All Electrified Fence and Hot Wire Products shall be ‘Premier Fencing Systems’, P.O. Box 89, Washington, IA, 52353 telephone: 800-282-6631, or approved equal, installed as per manufacturer’s instructions and as directed by the Birmingham Zoo and their representatives:

B. Hot Grass System shall be as fabricated and supplied by ‘Total Habitat’, 633 Lake Forest, Bonner Springs, KS 66012, contact Mick Hilleary, telephone: 316-644-5848; fax: 913-422-4834; email: mick@totalhabitat.com, or approved equal, installed as per manufacturer’s instructions and as directed by the Birmingham Zoo and their representatives.

C. System Components: provide the following components and equipment as required to provide a complete system for each type of electric barrier specified as indicated on the Drawings. Quantities are to be as are necessary to complete the layout as shown on the Drawings.

   Type A – 5’Height Fence
   1. 113800 Intellishock 284 Energizer 110vAC
   2. 131100 Fence Monitor 110vAC
   3. 131200 Fence Monitor Siren
4. 151000 Galv. Ground rod 6’ x 5/8” (see plans for ground rod length/quantity required)
5. 151800 SS Ground Rod Clamp
6. 156300 Lightning choke / diverter
7. 164100 Insulated Galv. Lead out wire (see plans for roll length required)
8. 251000 Maxishock wire, 14 GA, 7 strand (see plans for roll length required)
9. 337000 Manual Joint clamp 12.5g
10. 333000 HD Knife cut out switch
11. 132000 Digital Fence Voltmeter
12. 255010 SS P-Springs (Compression)

Type B – Habitat Moat Wall Mounting – 3’Height Hot Grass

1. 113800 Intellishock 284 Energizer 110vAC
2. 131100 Fence Monitor 110vAC
3. 131200 Fence Monitor Siren
4. 151000 Galv. Ground rod 6’ x 5/8” (see plans for ground rod length/quantity required)
5. 151800 SS Ground Rod Clamp
6. 156300 Lightning choke / diverter
7. 164100 Insulated Galv. Lead out wire (see plans for roll length required)
8. 337000 Manual Joint clamp 12.5g
9. 333000 HD Knife cut out switch
10. 255010 SS P-Springs (Compression)
11. ‘Econo Brown Hot Grass’ of the hot grass system as fabricated and supplied by Total Habitats in quantities necessary to complete the layout as shown on the Drawings.

Type C – Habitat Exclusion Planting Zones – 6’Height Hot Grass

1. 113800 Intellishock 284 Energizer 110vAC
2. 131100 Fence Monitor 110vAC
3. 131200 Fence Monitor Siren
4. 151000 Galv. Ground rod 6’ x 5/8” (see plans for ground rod length/quantity required)
5. 151800 SS Ground Rod Clamp
6. 156300 Lightning choke / diverter
7. 164100 Insulated Galv. Lead out wire (see plans for roll length required)
8. 337000 Manual Joint clamp 12.5g
9. 333000 HD Knife cut out switch
10. 255010 SS P-Springs (Compression)
11. ‘Tall Hot Grass’ of the hot grass system as fabricated and supplied by Total Habitats in quantities necessary to complete the layout as shown on the Drawings.

Type D – Habitat Exclusion Planting Zones – Hot Vines

1. Energizer – Not required, connect to Type C system within habitat
2. 151000 Galv. Ground rod 6’ x 5/8” (additional ground rods as required)
3. 151800 SS Ground Rod Clamp
4. 156300 Lightning choke / diverter (as required)
5. 164100 Insulated Galv. Lead out wire (see plans for roll length required)
6. 337000 Manual Joint clamp 12.5g
7. 333000 HD Knife cut out switch
8. 255010 SS P-Springs (Compression)
9. ‘Tree Hugging Hot Vines’ of the hot grass system as fabricated and supplied by Total Habitats in quantities necessary to complete the layout as shown on the Drawings.
   a. Refer to the Drawings for trunk diameters (DBH). Assume each tree designated for hot vine protection shall be protected up to 17’H around the trunk.
   b. Low Branch Protection: For each tree designated for hot vine protection,
assume four (3) limbs, 12" diameter, 15' long each, will be protected with the 'Tree Hugging Hot Vine’ system.

**Type E – Boma Yard Planting Zone Exclusion Fence**

1. 113800 Intellishock 284 Energizer 110vAC  
2. 131100 Fence Monitor 110vAC  
3. 131200 Fence Monitor Siren  
4. 151000 Galv. Ground rod 6’ x 5/8” (see plans for ground rod length/quantity required)  
5. 151800 SS Ground Rod Clamp  
6. 156300 Lightning choke / diverter  
7. 164100 Insulated Galv. Lead out wire (see plans for roll length required)  
8. 251000 Maxishock wire, 14 GA, 7 strand (see plans for roll length required)  
9. 337000 Manual Joint clamp 12.5g  
10. 333000 HD Knife cut out switch  
11. 132000 Digital Fence Voltmeter  
12. 255010 SS P-Springs (Compression)

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### 3. **EXECUTION**

#### 3.01 Installation of Electric Fencing System

A. Install all work in accordance with the requirements of the manufacturer and supplier of electric fencing components and all approved shop drawings.

#### 3.02 Hot Grass Touch-Up Painting

A. After installation apply touch-up paint to Hot Grass connection points as indicated by Hot Grass supplier.

#### 3.03 Fiberglass Rod Camouflage Painting

A. After installation apply camouflage paint to Fiberglass Rods. Provide for enough cans of 'Krylon' spray paint or equal to cover each rod with quick sprays of each of three colors to be approved by architect in order to blend Rods with adjacent planting and landscape.

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END OF SECTION
SECTION 14600 - HOISTS

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes: Low headroom single hook wire rope monorail hoist on motorized trolley for Elephant Building.

B. Related Sections:

1. Division 5 Section: "Structural Steel Framing" for I-beam monorail and connections.
2. Division 16 Sections: Electrical service and connections for crane and hoist equipment.

1.2  DEFINITIONS

A. Definitions of terms used in this Section are those in Glossary of ANSI MH27.1 as prepared by the Monorail Manufacturers Association (MMA).

1.3  SYSTEM PERFORMANCE REQUIREMENTS

A. General: Comply with applicable provisions of the latest editions of the following specifications and codes:

2. For Hoists: As follows:

   c. ANSI/ASME HST-4M Performance Standards for Overhead Electric Wire Rope Hoists.

3. AISC Specifications for Design, Fabrication and Erection of Steel for Buildings.
5. AWS D1.1 Code for Welding in Building Construction.
6. Occupational Safety & Health Act (OSHA).

B. Service Class: Design crane and hoist equipment and assemblies to comply with Class C (Moderate Service) as specified in ANSI MH27.1 Specifications; and for operation in normal ambient temperatures (0 to 40 deg C) and normal indoor conditions.

C. Vertical Impact: Include impact allowance in design calculations for carriers (trolleys, cranes and runway or monorail tracks, as follows:

1. Impact Allowance: 1/2 percent of the rated load for each foot per minute of hoisting speed, with minimum allowance of 15 percent and maximum allowance of 50 percent.

1.4  SUBMITTALS

A. Product Data: For each type of equipment specified. Include rated capacities, dimensions, performances, operations, safety features, controls, and the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements.
3. Features that will be included for Project.
4. Manufacturer's warranty.
B. Shop Drawings: Prepared by crane supplier, showing general arrangement of systems and equipment including plans, elevations and sectional views.

C. Panel Layout and Schematic Wiring Diagrams: Complete wiring diagrams showing electrical devices, numbered terminal strips, and wiring.

D. Maintenance Data: Two complete sets for equipment to include in maintenance manuals. Include the following:
   1. Key component breakaway pictures for parts ordering.
   2. Catalog cut pages.
   3. Part numbers.
   4. Sub-assembly details.
   5. Recommendations for periodic inspection and maintenance requirements.

E. Load Test Certification: Provide required Certification.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Source Limitations: Provide cranes and hoists specified in this section, including complete overhead handling system, from a single source and as a product of one manufacturer.

C. Manufacturer Qualifications: A firm regularly engaged in production of equipment of the type specified for this Project, with a record of successful in-service performance.

1.6 COORDINATION

A. Coordinate equipment locations with other work to prevent interference with clearances required for proper installation, adjustment, operation, cleaning, and servicing of cranes and hoists.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by crane system manufacturer agreeing to repair or replace equipment that does not comply with requirements or that fails during specified warranty period.
   1. Warranty Period: 2 years after date of Substantial Completion.

1.8 LOAD TEST

A. Load test per OSHA/ANSI at 125% of rating capacity at completion of installation and provide certification documents.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Product: Subject to compliance with requirements, provide products of R & M Materials Handling (800-955-9967), Spacemaster QXM 10-Ton Monorail Hoist, or approved equal.
   1. Authorized Dealer: Southeast Crane and Hoist (866-728-5140)
2.2 MATERIALS, GENERAL

A. General: Provide new materials for fabrication and erection of cranes and hoists.

2.3 TRACK ELECTRIFICATION

A. Conductor Bar: Roll-formed electrogalvanized steel sections, rated 140 amps continuous; bottom entry type.
   1. Insulation Cover: High visibility orange color, with operating temperature of 160 deg F.

B. Conductors: Complete with mounting brackets, insulators, couplings, end caps, and current taps.
   1. Provide separate conductors for each phase. More than one conductor in a single closure is not permitted.

C. Current Collectors: Sliding shoe type, spring loaded, and designed to minimize sparking and loss of contact.

2.4 TROLLEYS

A. Trolley Idler Heads and Drives: Articulating type; with articulated connection permitting rotational movement in one axis.
   1. Load Bars: Cradled in yokes to ensure that all wheels are in contact with operating flange at all times.

B. Yokes: Ductile castings, forgings, or steel fabrications; fixture machined.

C. Trolley Design: Facilitate easy removal of wheels at any point along track systems without removing carrier assembly from track.

D. Trolley Wheels: Made from high strength forged or machined steel, with not less than 5-inch tread diameter. Accurately machine wheel treads to ensure concentricity of axle and tread.

E. Wheel Bearings: Double row precision ball or taper roller bearings, lubricated and sealed at assembly; with bearings pregreased or regreaseable.
   1. Bearing Life: B-10 life of not less than 5,000 hours for Class C service.

F. Prohibitions: Flangeless wheels, and idler heads or drives that require side guide rollers are not permitted.

2.5 HOISTS

A. General: Provide low headroom hoist that is suitable for the particular application indicated, and complying with standards and requirements indicated.

B. Hoist Design: Design hoists and trolleys to withstand stresses imposed under operation conditions while handling loads within rated capacity.
   1. Design load bearing parts so static stress, calculated for rated load, does not exceed 20 percent of ultimate strength of material.

C. Controls: Provide cranes with controls as follows:
   1. Pushbutton Station: Type suitable for operation indicated, for each crane.
a. Pushbutton Arrangement: With strain relief protection.
b. Control Actuators: Dead-man type, with speed adjustment of multi-speed control obtainable by progressive depression of pushbutton elements to increase motor lift speed; with spring return to off position.

2. Radio Control Station: Remote unit for each crane.
   a. Provide one spare universal transmitter.

D. Braking System: Capable under normal operating conditions with rated load to stop and hold the load when controls are released.
   1. Controlled lowering shall be limited to 120 percent of rated lowering speed.
   2. In the event of complete power failure, load shall be stopped and held.

E. Bearings: Heavy duty, anti-friction type with B10 life not less than 5,000 hours. Motor bearings shall be lifetime lubricated, sealed ball bearings.

F. Gearing: Forged heat-treated alloy steel, machined for smooth, quiet operation; complying with AGMA quality specifications.

G. Bottom Locks: Fabricated from steel; completely shrouded for safety.
   1. Sheaves: Forged or rolled steel, running on anti-friction bearings.
   2. Hooks: Forged steel, supported by anti-friction thrust bearings, and permitting 360 degree rotation.
      a. Equip hooks with latches unless the application makes use of latches impractical.
      b. Provide a latch to bridge opening in hook for the purpose of retaining slings, chains, and similar elements under slack conditions.

H. Limit Switches: Each hoist shall incorporate an upper plugging type limit switch to automatically stop hoist motion when block reaches highest position. Excessive hook drift shall cause the block to momentarily reverse.

I. Electric Hoist Controls: Comply with N.E.C. requirements for application indicated. Include control circuit fusing and contactors mechanically and electrically interlocked.

2.6 FABRICATION

A. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Mark components of crane and hoist assemblies to allow for accurate field identification.

2.7 FINISHES

A. Preparation: Clean materials of loose rust, mill scale and foreign matter.

B. Painting: Apply one shop coat of manufacturer's standard finish to hoists, trolleys, runways and suspension fittings.

C. Protection: Protect equipment against damage and rust during shipping and handling.

2.8 CRANE SCHEDULE

A. General: Provide systems and equipment as indicated on Drawings, to comply with requirements specified, and as follows:
1. Elephant Building: One 10-ton capacity low headroom single hook wire rope monorail hoist on motorized trolley.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install crane and hoist equipment according to manufacturers' written instructions, using anchors appropriate to substrates and supports indicated and recommended by system manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Enclose wiring within housings of units or building construction. Do not use conduit exposed to view in finished spaces.

3.2 ADJUSTING

A. Adjust crane and hoist systems for unencumbered, smooth operation. Replace damaged or defective items.

B. Lubricate operating parts of cranes and hoists, including drive mechanism, safety devices, and hardware.

3.3 FIELD QUALITY CONTROL

A. Crane Testing: Upon nominal completion of crane and hoist system installation, and before permitting use, perform acceptance tests as required and recommended by referenced standard and by authorities having jurisdiction.

1. Perform a running test with crane unloaded, to demonstrate that controls and drive machinery operate properly.

3.4 DEMONSTRATION

A. Instruct the Owner's maintenance personnel in the proper use, operation, and maintenance of cranes and hoists. Review procedures to be followed in checking for sources of operational failures or malfunctions.

B. Check crane and hoist operation with the Owner's maintenance personnel present before time of Substantial Completion. Determine that control system, operating components, and safety devices are functioning properly.

END OF SECTION
SECTION 15010 – MECHANICAL GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The "General Conditions", "Supplementary Conditions", Statutory Declarations, Special Conditions and Division 1 of the specifications as written and referred to are adopted and made part of Division 15.

1.2 DESCRIPTION OF WORK:

A. Provide equipment, labor, material, etc., required to make a complete working installation as shown or as specified.

B. Equipment and materials used in the work shall be:

1. In accordance with the contract documents.
2. The best quality and grade for the use intended.
3. New and unused.
4. The manufacturer's latest standard or current model.

C. All equipment and method shall be installed and connected in accordance with the best engineering practices and in accordance with the manufacturer's recommendations.

D. Mechanical work includes, but is not limited to:

1. Make arrangements with local utility company for services as shown or specified.
2. Obtain all permits and inspections including: building permits, health department permits and sewer tap permits.
3. Disconnect, remove and re-install mechanical services located on or crossing through contract limits, above or below grade, obstructing construction of project or conflicting with completed project or any applicable codes.
4. Modify, extend or tie-into existing mechanical services or systems.
5. Complete the domestic water distribution system.
6. Complete the natural gas service.
7. Provide cutting of pavement, sidewalks, driveways, etc., excavating, trenching, shoring and de-watering. Provide backfill material and perform backfilling.
8. Restore site to original condition or new final grades. Provide paving, concrete, seed, or sod.
9. Complete the domestic hot and cold water system. Provide sanitary rinse and flush.
10. Complete the interior sanitary sewer.
11. Complete the interior storm water sewer.
12. Complete the interior natural gas service. Install valves, devices and specialties furnished by others.
13. Complete insulation on piping, ductwork and equipment.
14. Provide chemical treatment system.
15. Complete the Condensing units.
16. Complete the air handling systems, ventilating systems. fans, and blowers.
17. Complete the ductwork.
18. Complete the casing and plenums.
19. Install devices furnished by the Temperature Controls sub-contractor.
20. Testing and Balancing will be by an independent agency paid for by this contractor.
21. Provide vibration isolation devices for all rotating or reciprocating equipment and piping connected to that equipment.
22. Provide roofing including flashing, and counter flashing for roof mounted
equipment; roof penetrations and supports for work in this Division, unless noted otherwise.

1.3 UTILITY CONNECTIONS:

A. Arrange with local utility companies for utility service connections, taps, meters and installation. Pay all fees and charges (if any) necessary for the utility services shown on the drawings or listed in the specifications.

B. It is the responsibility of the Contractor to re-confirm with the Utility Companies, prior to bidding, that locations, arrangements, line sizes, pressures, interruptions, shut downs, etc. are in accordance with their regulations and requirements.

C. If the utility company requirements are at variance with these drawings and specifications, this Contractor shall include the utility company requirements in his work without additional cost to the Owner.

D. Obtain from Utility Company any additional charges for service of type, size and location called for. Include charges in bid to be paid by Contractor to appropriate party. Provide payment of these charges so as to allow logical progression of construction and avoid delay of completion.

E. Should cost above not be available prior to bid, submit with bid a letter signed by responsible Utility Company personnel stating that cost is not available. Prime Contractor shall submit letter with his bid to Owner. Cost will then be omitted from contract and become responsibility of Owner.

F. Furnish with shop drawings a signed document from each utility company describing location and type of service to be supplied and requirements for service. Document shall be signed by the appropriate responsible representative of the respective utility company.

1.4 WORK NOT INCLUDED:

A. Finish painting of piping, ductwork or equipment.

B. Electrical wiring and conduits shown on the electrical drawings.

C. Asbestos removal.

1.5 RELATED WORK SPECIFIED ELSEWHERE:

A. Electrical: Division 16.

1.6 REQUIREMENTS OF REGULATORY AGENCIES:

A. Obtain and pay for all permits required for the work. Comply with all ordinances pertaining to work described herein.

B. Install the work under this Division in accordance with drawings and specifications and the standards and codes (latest edition) that apply to this work. In the event of a conflict, install work in accordance with the most stringent code requirements determined by Architect.

C. Arrange, pay for and complete work to pass required tests by agencies having authority over work. Deliver to Architect Certificates of Inspection and approval issued by authorities.
1.7 QUALIFICATION OF CONTRACTOR:
   A. Has completed minimum two projects same size and scope in past five (5) years.
   B. This qualification applies to Sub-Contractors.
   C. Use workmen experienced in their respective trade. Submit qualifications of Superintendent for review.
   D. Owner reserves right to reject bid of any Contractor failing to meet these qualifications.

1.8 GENERAL JOB REQUIREMENTS:
   A. Drawings and Specifications:
      1. Work for the mechanical trades are shown on the drawings series M (HVAC), P (Plumbing) and FP (Fire Protection).
      2. Drawings and specifications are complementary. Work called for by one is binding as if called for by both.
      3. Drawings are drawn to a small scale and are diagrammatic only. The drawings indicate size and general arrangement of equipment.
      4. Do not scale drawings for exact locations. Refer to dimensional plans. Field measurements take precedence.
   B. Provide all necessary offsets, elbows and fittings in ductwork and piping as required to avoid conflict with work of other trades. Maintain proper headroom and clear passageways to allow adequate access and working clearances for equipment dampers, valves, etc. This shall be done at no additional cost to the Owner.
   C. Visit to Site/Work in other Division:
      1. Examine not only the plans and specifications for this Division, but plans and specifications of the other Divisions of work and visit the site to become acquainted with existing conditions. Execution of Contract is evidence that Contractor has examined all drawings and specifications, and that all conditions which have a bearing in any way on the manner of installing the work in this Division are known. Later claims for labor and materials required due to difficulties encountered will not be recognized.
   D. Underground Utilities/Concealed Utilities:
      1. All utilities and services, whether shown on the drawings or not, shall be suitably protected and maintained, and any damages thereto shall be promptly repaired. Owner shall be advised immediately of any damages sustained. If any extra expense is incurred due to the existence of buried utilities not shown on the drawings, or the location of which is not made known to the Contractor, the contract price shall be adjusted in accordance with the General Conditions. The Contractor shall advise the Owner three (3) days in advance of any operation which could possibly disrupt any underground utility. The Contractor shall utilize locator services to mark any underground utilities in the area he is working in, and shall make any other measure deemed necessary to avoid utility disruption.
   E. Definitions:
      1. **Concealed:** Materials or systems not visible. Work installed above a ceiling, furred behind a wall or enclosed in a chase.
      2. **Exposed:** Materials or systems that is visible. Work installed in a room
without a ceiling. Work not enclosed by walls.

3. Provide: Furnish, install and make complete.

4. Install: Receive, unload, move into place, and make connections.

5. Work: Materials completely installed and connected.


13. ASME: American Society of Mechanical Engineers.


18. MSS: Manufacturer's Standard Society of the Valve and Fittings Industry, Inc.


23. NSF: National Sanitation Foundation.

24. OSHA: Occupational Safety and Health Act.

25. PDI: Plumbing Drainage Institute.


27. SMACNA: Sheet Metal and Air Conditioning Contractors National Association.


29. UL: Underwriters Laboratories.
F. Workmanship, Warranty and Acceptance:

1. Work under this Division shall be first class with emphasis on neatness and workmanship.
2. Install work using competent mechanics, under supervision of foreman, all duly certified by local authorities. Installation subject to Architect's observation, final approval, and acceptance. Architect may reject unsuitable work.
3. Furnish Architect written warranty, stating that if workmanship and/or materials executed under this Division are proven defective within one (1) year after final acceptance, such defects and other work damaged will be repaired and/or replaced.
4. In event that project is occupied or system placed in operation in several phases at Owner's request, warranty will begin on date each system or item of equipment is accepted by Owner.

G. Observations of Work and Demonstration of Operation:

1. When observations are scheduled, provide sufficient personnel to expedite removal of access doors, coverplates, manholes covers, etc.
2. Contractor to assist Architect in demonstration of operation of new systems to satisfaction of Owner. Contractor to have manpower available for demonstration of systems where requested by Owner.

H. Materials and Substitutions:

1. All materials shall be new. All materials and equipment, for which a UL Standard, an AGA approval, an AWWA standard, FM listing or ASME requirements is established, shall be so approved and labeled or stamped.
2. Wherever in these specifications products are specified by manufacturer's name, bids shall be based on the named products. Where more than one manufacturer's name is mentioned, the one first listed establishes the standard for that product. If the bidder desires to submit a product of a manufacturer other that listed first, it must be the equivalent of the one listed first.
3. The drawings are based on the use of products specified and listed first. If any revision in piping, ductwork, conduit work, foundations, anchor bolts, connections, etc., is required by other named products or approved substitutions, it shall be the Contractor's responsibility to make such revisions at no additional expense to the Owner.
4. If any bidder desires to submit products of manufacturers not listed, he may submit a request for prior approval to the Engineer no later than 10 days prior to the bid date. If the Engineer decides to accept the manufacturers, they will be listed as "Approved" by written addendum.
5. If the manufacturers are not listed as approved either by addendum or in the specifications, they will not be accepted.
6. Submit to Architect within 14 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer or list does not constitute approval of specific material or equipment.

I. Shop and Erection Drawings:

1. Submit complete shop drawings for all materials and equipment furnished under Division 15 of specifications, to Architect for review within 30 days after award of contract. Shop drawings shall be submitted on a timely basis to allow adequate lead time for review, resubmission if necessary, manufacture and delivery to allow access of material to project at correct time based on schedule established by Architect/Contractor. On each shop drawing include the specification section.
that applies to that submittal. Include complete descriptive data with dimensions, operating data and weight for each item of equipment. Carefully examine shop drawings to assure compliance with drawings and specifications prior to submittal to Architect. Shop drawings and submittals shall bear the stamp of approval of the Contractor as evidence that the drawings have been checked by him. Drawing submitted without this stamp of approval will not be considered and will be returned for proper resubmission.

2. Drawings larger than 8-1/2" x 11", submit three (3) copies and one (1) reproducible of each drawing. Architect will retain two (2) copies and return one (1) reproduction and one (1) copy to Contractor. Contractor is responsible for copying reproducible for distribution.

3. 8-1/2" x 11" drawings in brochure: Submit six (6) original copies for review. Architect and Engineer will retain two (2) copies and return four (4) copies to Contractor. Division 1 "General Conditions" take precedence over this specification.

4. Review of shop drawings does not relieve Contractor of responsibility for errors and omissions in shop drawings. Contractor's responsible for meeting the requirements of the contract documents.

5. Contractor is responsible for dimensions and sizes of equipment. Inform Architect in writing of equipment differing from that shown.

6. Prepare erection drawings when required by Architect. Investigate thoroughly all conditions affecting work and indicate on drawing. Architect will review erection drawings before work commences.

7. Coordination shop drawings shall be prepared for the entire project. Coordination shop drawings shall be developed by the following sequence: See Electrical.

J. Operating and Maintenance Manuals:

1. Provide maintenance and operating manuals bound in 8-1/2" x 11" hardback, three-post binders. Manuals shall contain written instructions for each system, shop drawings, schematic drawings, equipment catalog cuts, manufacturer's instructions, manufacturer's warranties, and valve tag list.

2. Arrange information in the following sequence: title of job, Owner, address, date of submittal, name of Contractor, name of Engineer, index, shop drawings, operating instruction, Contractor's purchase order numbers, supplier's name and address, date of start-up of each piece of equipment and valve tag list.

3. Submit one (1) copy for review. Make required corrections, and submit two (2) record copies.

K. Record Drawings:

1. Contractor shall maintain at the site one (1) copy of the drawings in good order and marked to record all changes made during construction.

2. Contractor shall update all drawings to incorporate all changes and deliver one (1) set of reproducible Mylar plans and one (1) electronic copy of the project in the latest "AutoCAD" version to the Owner upon completion of the work.

L. Provide the following items for Owner at time of substantial completion:

1. Certificates of inspection and approval from authorities having jurisdiction.

2. Warranties.

3. "Record" blue line prints.

4. Operating and Maintenance Manuals (3 copies).

5. Spare Parts (furnish receipt).

6. Affidavit of Owner Instruction (1 copy).

7. Release of Liens.
1.9 PROTECTION AND STORAGE:

A. Provide warning lights, bracing, shoring, rails, guards and covers necessary to prevent damage or injury.

B. Protect all equipment and materials, from damage by weather, entrance of water or dirt. Cap open piping, use plastic covers made for that purpose. Do not use rags or construction debris.

C. Avoid damage to materials and equipment in place. Repair, or remove and replace damaged work and materials.

D. Protect all surfaces from weld spatter, solder and cutting oil.

E. Deliver equipment and materials to job site in original, unopened, labeled container. Store to prevent damage and injury. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloreding. Store materials affected by condensation in warm dry areas. Provide heaters. Storage space on site and in building designated by Owner/Architect.

END OF SECTION
SECTION 15030 - COORDINATION

PART 1 - GENERAL

1.1 DRAWINGS FOR MECHANICAL AND ELECTRICAL WORK

A. Drawings contain diagrammatic layouts and indicate general arrangement of systems, piping conduit, etc.

B. Prior to installation of material and equipment, review and coordinate work with Architectural and Structural Drawings and other Division work for exact space conditions; where not readily discernable request information from Architect before proceeding.

C. Check Drawings of all other trades to verify extent of material and equipment to be installed in spaces available and consider layout alternatives so that all requirements can be accommodated.

D. Maintain maximum headroom at all locations without finished ceilings.

E. Maintain finished ceiling heights as indicated on Architectural reflected ceiling plans, and building sections and elevation drawings.

F. Coordinate installations with other trades prior to proceeding to prevent conflict with work of other trades and cooperate in making reasonable modifications in layout as needed.

G. Where conflicts occur with placement of mechanical and electrical materials as they relate to placement of other building materials, the Architect shall be consulted for assistance in coordination of the available space to accommodate all trades.

H. Coordinate equipment installation to maintain manufacturer and code required working clearances

1.2 PRIORITY OF CONSTRUCTION SPACE

A. Following is the Order of Priority for Construction Space:

1. First: Ductwork.
2. Second: Other piping.
3. Third: Conduit.

1.3 COORDINATION DRAWINGS

A. The Contractor shall prepare a complete set of "Cronoflex Mylar" type background drawings at scale of minimum 1/4" equals 1'-0".

1. The construction documents in their original, copies or electronic file form are the Architect's instrument of service and are protected under copyright laws. The reproduction of these documents for use as coordination drawings or shop drawings is prohibited without the Architect's written consent and authorization.

B. Each specialty trade listed below shall prepare a coordination Mylar overlay indicating his work, with appropriate elevations and grid dimensions.

C. Each specialty trade shall sign and date the coordination Drawing after the addition of his information.

D. Fabrication shall not start until receipt of completed coordination drawings is
acknowledged by the Contractor in writing to the Architect.

E. Specialty Trades:
1. Ductwork
2. Other piping
3. Electrical
4. Plumbing piping to include but not limited to sanitary, vent, pressure storm, natural gas, etc.

F. Coordination Drawings required for all mechanical rooms, electrical rooms, equipment rooms, corridors, horizontal exits from duct shafts, cross overs and any other areas where congestion of work may occur.

G. Coordination Schedule Drawing:
1. The mechanical and plumbing contractor shall furnish to electrical contractor for coordination a schedule drawing providing all the electrical characteristics of all mechanical and plumbing equipment requiring electrical connection. The information provided shall include:
   a. Unit Designation
   b. Voltage
   c. MCA
   d. MOCP/MFS
   e. FLA
   f. Disconnect Requirement
   g. Starter Requirement
   h. Alarm Wiring Requirements

2. The coordination schedule drawing, once received by the electrical contractor, shall be reviewed and all pertinent electrical accommodations indicated.
   a. Breaker size.
   b. Wire size / conduit size.
   c. Disconnect with fuse size.

3. Once the coordination schedule is completed forward to the engineers for review and approval.

H. Any deviation in the mechanical equipments which results in a change in the electrical scope of work shall be the responsibility of the mechanical contractor. The mechanical contractor shall reimburse the electrical contractor for any cost. No added cost to the owner will be allowed.

I. Conflicts that arise due to the fact that the coordination schedule drawing was not completed shall be the sole responsibility of the contractors. All costs for correction or remedial work shall be done at the contractor’s expense. No added cost to the owner will be allowed.

END OF SECTION
SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 CODES AND STANDARDS:

A. Clean Air Act 1990
B. Refrigeration Service Engineers Society

1.3 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems
2. Transition fittings
3. Dielectric fittings
4. Mechanical sleeve seals
5. Sleeves
6. Escutcheons
7. Grout
8. Equipment installation requirements common to equipment sections
9. Painting and finishing
10. Access Panels
11. Fire stopping
12. Piping Seals
13. Roof Mounting Curbs
14. Pipe Supports
15. Pipe Identification
16. Valve Tags and Charts

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following are industry abbreviations for plastic materials:

2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings
2. Dielectric fittings
3. Mechanical sleeve seals
4. Escutcheons
5. Access Panels
6. Fire stopping
7. Piping Seals
8. Roof Mounting Curbs
9. Pipe Supports
10. Pipe Identification
11. Valve Tags and Charts

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.

   2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Elson Thermoplastics.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers:
      a. Thompson Plastics, Inc.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.
E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:
   b. Fernco, Inc.
   d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- minimum working pressure as required to suit system pressures.

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.
G. **Dielectric Nipples:** Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. **Manufacturers:**
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.

### 2.6 MECHANICAL SLEEVE SEALS

A. **Description:** Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. **Manufacturers:**
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. **Sealing Elements:** **EPDM** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. **Pressure Plates:** **Stainless steel.** Include two for each sealing element.

4. **Connecting Bolts and Nuts:** **Stainless steel** of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.7 SLEEVES

A. **Galvanized-Steel Sheet:** 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. **Steel Pipe:** ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. **Cast Iron:** Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

D. **Stack Sleeve Fittings:** Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. **Under deck Clamp:** Clamping ring with set screws.

E. **Molded PVC:** Permanent, with nailing flange for attaching to wooden forms.

F. **PVC Pipe:** ASTM D 1785, Schedule 40.

G. **Molded PE:** Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

### 2.8 ESCUTCHEONS

A. **Description:** Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. **One-Piece, Deep-Pattern Type:** Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: **Polished chrome-plated**.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: **Polished chrome-plated**.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

   1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.

2.10 FIRESTOPPING:

A. Fire stopping materials shall conform to ASTM E 814 and E 119.

B. Penetration Sealants:

   1. Flame Stop Distribution, Inc., Flame Stop V.
   2. 3M Brand "Fire Barrier" CP 25 WB Caulk.
   3. 3M Brand Moldable Putty "Pads" and Moldable Putty MPS-2 "Stix."

C. Intumescent Sealants for use in openings and sleeves involving plastic pipe, insulated pipe or flexible cable:

   1. Flame Stop Distribution, Inc. Flame Stop VP with Retaining Fixture.
   2. 3M Brand "Fire Barrier" Caulk, with FS-195 Wrap Strip and CS-195 Composite Sheet.

2.11 MISCELLANEOUS STEEL:

A. ASTM A-36 Structural Steel

2.12 ROOF MOUNTED CURBS/PIPE SUPPORTS:

A. Roof Curbs: Minimum 14 ga galvanized steel, fully mitered and welded corners with integral base plates, internally reinforced with 1 in. x 1 in. x 1/8 in. steel angle. Units shall have pressure treated wood nailers, and 1-1/2 in. thick, three pounds per cubic foot (PCF) density fiberglass insulation. Curbs shall be fabricated With cant. Minimum height of curb shall be 8 in. above finished roof.

   B. Curbs shall be Custom Curb, Inc, Louvers and Dampers or Thycurb.
C. Construct curbs to match slope of roof and provide level top surface for mounting of mechanical equipment.

D. Pipe Supports: minimum 18 ga galvanized steel with fully mitered and welded corners, integral base plates and factory installed pressure treated nailer. Units shall be at least 24 in. long with two galvanized steel support channels welded to "U" shaped mounting brackets and secured to side of equipment rail with lag bolts. Counter flashing shall be 20 gauge galvanized steel welded water tight. Pipe supports shall be Roof Products and Systems Corp. style ER-2A, Custom Curb, Inc. or Pate Company. Minimum height of support shall be 8 in. above finished roof.

2.13 PIPE IDENTIFICATION:

A. Identification shall be in accordance with ANSI-A13.1. Pipe markers shall be Brady B-946 or Seton's Weather-Code.

2.14 VALVE TAG AND CHART:

A. Valve tags shall be Seton 250-BL with heavy brass chain. One valve number shall be stamped on each tag. Identify each valve tag for the utility it serves, such as "CW" for cold water, HW for hot water, etc. Valve charts shall be Seton A-11P.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and
calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
   g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.

f. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.

g. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

   ♦ Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 7 Section "Through-Penetration Fire stop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Non-pressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasket Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasket Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer’s written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.
3.6 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section.

B. Concrete Housekeeping Pads:

1. Provide concrete housekeeping pads under all floor mounted equipment, pipe support and duct supports and where indicated.

2. Housekeeping pads shall be not less than 3 ½ thick, sized at least 8 in. larger than the equipment.

3. Pads shall be doweled to floor with not less than 4 No. 4 bars grouted in place.

4. Pads shall have chamfered edges.

5. Pads shall receive a broom finish.

NOTE: Anchor bolts for equipment shall be poured integral with the pad.

6. Pads shall be reinforced with at least one No. 4 bar (stirrups).

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
C. Attach to substrates as required to support applied loads.

3.10 GROUTING
A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

3.11 ACCESS PANELS:
A. Provide access panels in walls and ceilings as needed to allow access to valves, equipment, shock absorbers, trap primers, etc. and where noted.
B. Access doors shall be selected for the type of wall or ceiling where needed. All locking access panels shall be keyed alike [Keyed to match existing panels].

3.12 FIRE STOPPING:
A. Provide penetrations for piping through floors and walls for work under this contract.
B. Penetrations through floors and fire resistant walls shall be sealed to the rated fire resistance equal to the wall. Installation shall be done by a qualified installer, approved by the manufacturer.
C. Provide sound proofing through non-rated walls.
D. In an existing building all penetrations through floors and fire resistant walls shall be sealed at the end of each working day. These closures shall have an equal fire resistance rating to the floor or wall.

3.13 EXCAVATION, SHORING AND BACKFILL:
A. Provide any excavation required for work in this Division. Refer to soil borings for type of sub-grade materials.
B. Provide separate trench for each utility.
C. Provide bracing, shoring, sheet piling to protect sides of excavation, workers and adjacent structures. Provide site de-watering systems where water level is above bottom of trench.
D. Provide barricades and lights to protect open excavations. Provide pedestrian bridges for foot traffic across excavation.
E. Provide steel plates over excavations for automobile and truck traffic across excavations.

F. Remove all timber and foreign material from excavation before backfilling. Backfill simultaneously on both sides of tanks, piping, etc. Backfill materials shall be approved clay or chert, free of debris, rock larger than 1-1/2 inch or other harmful material.

G. Backfilling shall be done in 12 in. lifts or layers. All backfilling shall be compacted to the Modified Proctor Density (ASTM D-1557) listed below:

<table>
<thead>
<tr>
<th></th>
<th>90 Percent</th>
<th>95 Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under sidewalks</td>
<td>paved areas</td>
<td>under structures</td>
</tr>
<tr>
<td>Grassed areas</td>
<td>Building slabs</td>
<td></td>
</tr>
</tbody>
</table>

H. Restore existing pavement, curbs, sidewalks, sodding, etc. removed or damaged by work in this Division.

3.14 ANCHORS:

A. Mount all equipment, brackets, hangers, anchors, etc. to safely resist the vibration or thrust forces and support the unit's weight.

B. Floor mounted rotating or vibrating equipment shall be anchored to the floor using grouted-in-place or cast-in-place anchor bolts with three inch hook and sleeve. Anchor bolts shall be of the size recommended by the manufacturer.

C. Floor mounted static items, wall and ceiling mounted equipment bracket and hangers shall be installed using drilled anchors or cast in place inserts. Anchors shall be Phillips Drill Company "Red Head" or Multi-Set II. Size anchors and inserts for four times the applied load. Bolts used outdoors or in a wet environment shall be hot dip galvanized.

3.15 SOUND LEVELS:

A. Select diffusers, grilles, terminal boxes, and equipment so as not to exceed the NC curve rating for the various areas. Equipment and materials furnished shall be rated in accordance with the sound power tests measured in accordance with ASHRAE Standard 36B-63. Room attenuation and ceiling transmission loss shall depend on the spaces and architectural finishes.

B. Attenuation allowances shall be as follows unless scheduled otherwise:

<table>
<thead>
<tr>
<th>Material</th>
<th>Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustical tile</td>
<td>-4dB</td>
</tr>
<tr>
<td>Plaster ceiling</td>
<td>-1dB</td>
</tr>
<tr>
<td>5/8 in. gypsum ceiling</td>
<td>-1dB</td>
</tr>
<tr>
<td>Room attenuation effect</td>
<td>-8dB</td>
</tr>
</tbody>
</table>

C. Air performance tests shall be conducted in accordance with Air Diffusion Council (ADC) Equipment Test Code 1062 RI and ratings approved by the ADC.

D. Maximum sound pressure levels for installed material and equipment shall be as follows:

<table>
<thead>
<tr>
<th>Area</th>
<th>NC Curve Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cafè</td>
<td>35</td>
</tr>
</tbody>
</table>

3.16 FLASHING:
A. Provide flashing at piping and duct penetrations through roof and roof mounted structures furnished under this Division. Flash in accordance with Roofing manufacturer’s details.

B. Flashing materials shall be in accordance with the roofing manufacturers system.

C. Provide flashing at pipes passing through floors with waterproof membrane. Flashing shall be in accordance with waterproofing manufacturer’s details.

3.17 ROOF TOP WORK:

A. Protect roof surface by using plywood walkouts, work platforms, and cribbing during construction.

B. Provide counter flashing unless specifically included in the work of another Division. Counter flashing shall be in accordance with roof manufacturer’s instructions such that roof warranty is maintained.

C. Provide a certificate of inspection from the roof manufacturer stating that the roof has been repaired in accordance with their specifications and that the warranty remains in effect.

3.18 PIPE IDENTIFICATION:

A. Provide pipe markers and directional arrows on pipes at both sides of partitions and floors slabs, at branch line take-offs, at valves, at intermediate intervals not in excess of 20 ft. and at connections to equipment.

B. Tape color band identifying markers and arrows on each pipe, both insulated and bare pipes. Pipe markers and arrows shall be located where readily visible and on lower quadrants of overhead pipes.

C. Submit schedule of pipe markers, with legend and background colors for approval by the Architect.

3.19 VALVES TAGS AND CHART:

A. Attach a numbered valve tag to each valve.

B. Provide a type written chart in frame under glass cover, giving the full list of all valves installed under this contract. Chart shall list valve number, type of utility, and location. Mount chart where directed by Owner. Provide one additional copy to Owner.

3.20 EQUIPMENT IDENTIFICATION:

A. Stencil on the equipment the functional name and equipment number of each piece of equipment as it is scheduled, i.e. pumps, tanks, fans, chillers, air handling units, water softeners, etc.

B. Stencil letters shall be black 1 in. high, located on a white background.

C. Identify each piece of equipment with a 1/8 inch thick engraved melamine plastic laminate nameplate. Letters shall be 1/2 inch high standard style. Names, abbreviations, and numbering shall agree with the corresponding equipment designations shown on the drawings. Use black letters cut in a white background for all equipment on standard electrical power and use white letters cut in a red background for all equipment on emergency power. (Coordinate with Division 16 "Electrical" Contractors).
D. Fasten nameplates to equipment in a conspicuous location using self-tapping stainless steel screws, except use contact epoxy adhesive where screws cannot or should not penetrate substrate.

3.21 REFRIGERANT RECOVERY:
A. All work on refrigerant systems shall employ service techniques that prevent release of refrigerants to the atmosphere.
B. Remove all refrigerant. Place refrigerant in DOT approved containers for recycling/re-use.

3.22 WORKMANSHIP:
A. Pipe size changes shall be made at reducing fittings. Bushings shall not be used.
B. Provide drain valves at points where water is trapped in piping.
C. Install pipe to prevent noise or water hammer.
D. Blowout or flush out all lines prior to final connection or start-up, to remove foreign matter.
E. Make allowance in piping for expansion and contraction, for installation of insulation and to avoid air pockets.
F. Do not tap small pipes into larger pipes. Provide fittings or reinforced branch connections.
H. Pull up threaded fittings to a tight fit with an approved good quality pipe joint compound applied to male threads.
I. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts apply compound and remake joints.
J. Clean piping strainers after start-up by removing strainer screen and wire brushing.
K. Conceal pipes in pipe shafts, partitions and furred spaces except where otherwise distinctly indicated on the drawings. Each riser shall be separately valved.
L. Every branch pipe shall be controlled by a valve where it connects to the supply main or riser.
M. Valves shall be easily accessible, with proper clearance for maintenance. Valves inside furred spaces, behind access doors shall be grouped to keep the number of access doors and their sizes to a minimum.
N. Provide drain valves at the base of each riser.
O. Provide drain valves and drain lines from pumps, heaters, water cooled equipment, relief valves, etc., and pipe to floor drains.
P. Tighten flanges and packing glands after the system has been placed in operation. Replace gaskets in flanges that show any signs of leakage after tightening.
Q. Install NO piping in electrical switchgear room, transformer vaults, telephone rooms or electrical closets. Provide drip pans under drain piping above electrical switchgear in mechanical rooms.

R. Install piping in alignment with and parallel to the walls of the building. All risers shall be plumb.

S. No cross connections shall be installed between potable water systems and polluted supply or waste systems.

T. Provide valves and unions or flanges at equipment such as pumps, coils, tanks, automatic valves, heat exchangers, etc. Provide valves on capped branches for extension by other contractors.

U. Support piping at the proper intervals. Adjust pipe hangers and supports for correct pitch and alignment. Brace piping systems which sway.

V. Remove rust, scale, and foreign materials from equipment and renew any defaced surfaces. If equipment is marred, provide new materials.

W. Protect insulation. Repair insulation that is damaged. Keep it dry and free of tears. Allow no punctures in vapor barrier. Insure good tape adhesion. Provide smooth surfaces in finished areas.

X. Pitch sanitary and storm lines: pipes 3 in. and larger not less than 1/8 inch per foot, pipes 2 inch and smaller not less than 1/4 inch per foot. Make changes in grade or direction by "Y" branches.

Y. Pitch vent piping to free themselves of water and condensation. Install vent branches not less than 42 inches above floor. Clean fixtures of labels and stains with whiting and alcohol. Clean copper tubing and fittings with steel wool to remove traces of oxidation.

Z. Install ductwork to allow adequate clearance for maintenance. Locate fire dampers and access doors to allow replacement of fusible links. All dampers shall be accessible.

AA. All copper tubing shall be hard drawn unless noted otherwise. Annealed tubing where used shall be stretched, and installed with tool formed bends.

END OF SECTION
SECTION 15140 - SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
   
   A. This specification describes the fabrication and installation requirements for equipment supports, pipe supports, pipe anchors, pipe guides and brackets.
   
   B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 SUBMITTALS:

   A. Submittals shall include the following information and data:

       1. Manufacturer's Data Sheets on all catalog items to be used.
       2. Sketches covering all specially designed assemblies and fabrications.
       3. Sketches showing locations, loads, calculated travel, types and sizes of all spring hanger assemblies.
       4. Sketches covering all anchor and guide assemblies.

1.3 STANDARDS:

   A. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
   B. Standard SP-58 Pipe Hangers and Supports-Materials, Design and Manufacture
   C. Standard SP-69 Pipe Hangers and Supports-Selection and Application
   D. Standard SP-89 Pipe Hangers and Supports-Fabrication and Installation Practices.
   E. Standard SP-90 Guidelines on Terminology for Pipe Hangers and Supports
   F. ANSI/ASME B31 Codes for Pressure Piping
   G. ASME Boiler and Pressure Vessel Codes
   H. FM 1951 Factory Mutual - Approved Standard for Pipe Hanger Components for Automatic Sprinkler Systems
   J. AISC Manual for Steel Construction

PART 2 - PRODUCTS

   A. Hangers for suspending pipe 2-1/2 in. and larger shall be capable of vertical adjustment.
   B. Hangers and supports for chromium plated piping shall be bright nickel chromium plated.
   C. Steel and malleable iron hangers sized for copper tubing shall be copper plated.
D. Pipe slides shall be fabricated to accommodate full thickness of insulation.

E. Hangers, devices and hardware located outdoors shall be hot dip galvanized.
Horizontal Pipe Attachments: (Cast Iron Pipe, Ductile Iron Pipe, Steel Pipe, FRP & PVC Pipe, and Copper Tubing larger than four inches) Type numbers as defined in MSS-SP-58

---INDICATES NOT NORMALLY USED
X  INDICATES ACCEPTABLE APPLICATION
NA  INDICATES NON-ALLOWABLE

<table>
<thead>
<tr>
<th>TYPE 1</th>
<th>Adj. Steel Clevis Hanger Grinnell, B-Line</th>
<th>(INSULATED) Hot Lines</th>
<th>(UN-INSULATED) Ambient X</th>
<th>(INSULATED) Cold X</th>
<th>FIRE PROTECT. U.L. LISTEDX</th>
<th>(UN-INSULATED) PLUMBINGX</th>
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<tbody>
<tr>
<td>TYPE 3</td>
<td>Double Bolt Pipe Clamp</td>
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<td>X</td>
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<td>X</td>
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<tr>
<td>TYPE 4</td>
<td>Steel Pipe Clamp</td>
<td>NA</td>
<td>X</td>
<td>NA</td>
<td>X</td>
<td>X</td>
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<tr>
<td>TYPE 5</td>
<td>Pipe Hanger</td>
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<td>TYPE 10</td>
<td>Adj. Swivel Ring Band Type</td>
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<tr>
<td>TYPE 36</td>
<td>Pipe Saddle Support</td>
<td>X Note 1</td>
<td>X</td>
<td>X Note 1</td>
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<td>X</td>
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<tr>
<td>TYPE 37</td>
<td>Pipe Stanchion Saddle</td>
<td>X Note 1</td>
<td>X</td>
<td>X Note 1</td>
<td>NA</td>
<td>X</td>
</tr>
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<td>TYPE 38</td>
<td>Adj. Pipe Saddle Support</td>
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<td>TYPE 41</td>
<td>Single Pipe Roll</td>
<td>X Note 3</td>
<td>--</td>
<td>X Note 1</td>
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<tr>
<td>TYPE 43</td>
<td>Adj. Roller Hanger w/ Swivel</td>
<td>X Note 3</td>
<td>--</td>
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<td>TYPE 44</td>
<td>Pipe Roll Complete</td>
<td>X Note 3</td>
<td>--</td>
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</tr>
<tr>
<td>TYPE 45</td>
<td>Pipe Roll &amp; Plate</td>
<td>X Note 3</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>TYPE 46</td>
<td>Adj. Pipe Roll &amp; Base</td>
<td>X Note 3</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: 1. Hangers on insulated piping systems shall incorporate protection saddles or shields (MSS-SP-58).
2. The design shall be in accordance with MSS SP-58.
3. For shields used with rollers or subject to point loading, see table for Type 39 saddles (MSS SP-58).
4. Continuous inserts, anchor bolts and concrete fasteners may be used as specified by the Engineer.
Vertical Pipe Attachments/Hanger Rod Fixtures
Type numbers as defined in MSS-SP-58

<table>
<thead>
<tr>
<th></th>
<th>(Insulated) Hot Lines 120 - 240°F</th>
<th>Ambient 60-120°F</th>
<th>(Insulated) Cold Line 59° and below</th>
<th>Fire Protection (U.L. Listed)</th>
<th>(Uninsulated) Plumbing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 8 - up to and incl. 8&quot; pipe riser clamp Grinnell, B-line</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Type 42 - 10&quot; pipe and larger double bolt riser clamp</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>NA</td>
<td>X</td>
</tr>
</tbody>
</table>

Motion and Movement Control

<table>
<thead>
<tr>
<th>Item</th>
<th>MSS-SP-69 Type No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller Hanger with Swivel</td>
<td>43</td>
</tr>
<tr>
<td>Pipe Roll</td>
<td>44, 45, 46</td>
</tr>
<tr>
<td>Restraint</td>
<td>47</td>
</tr>
<tr>
<td>Spring Cushion</td>
<td>48</td>
</tr>
<tr>
<td>Spring Cushion Roll</td>
<td>49</td>
</tr>
<tr>
<td>Spring Sway Brace</td>
<td>50</td>
</tr>
<tr>
<td>Variable Spring Hanger</td>
<td>51</td>
</tr>
<tr>
<td>Variable Spring Base Support</td>
<td>52</td>
</tr>
<tr>
<td>Variable Spring Trapeze Hanger</td>
<td>53</td>
</tr>
<tr>
<td>Constant Support-Horizontal</td>
<td>54</td>
</tr>
<tr>
<td>Constant Support Vertical</td>
<td>55</td>
</tr>
<tr>
<td>Constant Support Trapeze</td>
<td>56</td>
</tr>
<tr>
<td>Horizontal Traveler</td>
<td>58</td>
</tr>
</tbody>
</table>

2.1 GUIDES AND SLIDES:

A. Guides shall be spider type with at least four radial legs attached to the pipe. Pipe motion shall be restrained by circular housing. Each unit shall have support legs for bolting or welding.

B. Slides shall be "T" Type with fabricated or structural steel tee section, base plate and PTFE sliding surface. Brackets and hold-down lugs shall be provided on slides for longitudinal motion only.
2.2 MISCELLANEOUS:

A. Hanger Rod - ASTM-A36 or A 575 Threaded Hot Rolled Steel

B. Upper Attachments

<table>
<thead>
<tr>
<th>Item</th>
<th>MSS SP 69 TYPE NO.</th>
</tr>
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<tbody>
<tr>
<td>Side Beam or Channel Clamp</td>
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<tr>
<td>Center Beam</td>
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<td>31, 32, 33</td>
</tr>
<tr>
<td>Side Beam Bracket</td>
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</table>

2.3 STRUCTURAL STEEL:

A. All structural steel components used in the fabrication of supports, guides, etc. shall be ASTM A-36 or ASTM A 500 Grade A or B structural steel.
PART 3 - EXECUTION

3.1 GENERAL:

A. Repair/replace fire proofing on structural beams where it is removed or damaged for work under this section. Repair/replacement shall be done by an approved and qualified tradesman.

B. Drill for anchors in structural slabs and walls. Anchors shall be Phillips Drill Company "Red Head", or Multi-Set II. Hilti Fasteners, Rawlplug Company and Wej-it Corporation are approved equal. Powder actuated fasteners are prohibited.

C. Support piping independent of pumps, adjacent piping and equipment.

D. Structural supports shall be designed in accordance with AISC - Manual for Steel Construction. Support from the floor all horizontal piping with a centerline elevation less than four feet from the floor.

3.2 STRUCTURAL STEEL:

A. All steel framing, weldments and miscellaneous steel necessary for the installation of supports, guides, anchors, etc. shall be designed in accordance with the AISC Steel Handbook. Steel shall be shop fabricated, furnished by the contractor. Steel shall receive one shop coat of primer.

B. Attach wall mounted pipe supports for exposed piping on dry wall construction to angle or channel supports framed into wall studs.

C. Support exposed piping on walls with split cast iron pipe holders.

D. Supports, guides, and anchors shall be so designed that excessive heat will not be transmitted to the building steel. The temperature of supporting parts shall be based on a temperature gradient of 100 degrees F per inch distance from the outside surface of the pipe. Temperature at point of contact to the building structure shall not exceed 100 degrees F.

E. Support piping systems by using standards manufactured hangers and supports wherever possible.

F. All pipe hangers and supports shall allow for the expansion and contraction of the piping systems.

3.3 VERTICAL:

A. Support vertical pipe at base and at each floor. In addition, 1 inch or smaller copper pipe shall be supported at 5 foot intervals.

B. Pipe support attachments to the riser piping shall be riser clamp lugs. Welded attachments shall be of material comparable to that of the pipe, and designed in accordance with governing codes.

C. Support vertical pipe independently of connected horizontal pipe. Use riser clamps which extend beyond the insulation to support the weight of the pipe.

3.4 HORIZONTAL:

A. Use wall brackets to suspend or support pipe runs near walls. Hanger rods shall be used in tension only. Install rods plumb, limit rod travel to 4 degrees from vertical.
B. Multiple adjacent pipes at the same bottom-of-pipe elevation may be supported from Unistrut, Kindorf or B-Line channel trapeze hanger.

C. Cold systems (Fluid temperatures below 59 degrees F):
   1. Install pipe hangers and supports with insulation protection shield. Hangers and supports must be sized to fit the outside diameter of the pipe insulation.

D. Hot Systems (Fluid temperatures 140 degrees F and higher):
   1. Install pipe hangers with insulation protection shield on lines with minimal thermal growth (less than 1 in.). Install pipe covering protection saddles on line with longitudinal thermal growth exceeding 1 in. Use traveling hanging devices for suspended lines and slides, rollers or roller carriages for pipes supported from below. All devices must be sized to fit the outside diameter of the pipe insulation.
<table>
<thead>
<tr>
<th>NOMINAL PIPE SIZE TUBING O.D. (IN.)</th>
<th>STEEL SUPPORT SPACING (FT.)</th>
<th>ROD SIZE (IN.)</th>
<th>COPPER SUPPORT SPACING (FT.)</th>
<th>ROD SIZE (IN.)</th>
<th>CAST IRON SUPPORT SPACING (FT.)</th>
<th>ROD SIZE (IN.)</th>
<th>PVC/PP SUPPORT SPACING (FT.)</th>
<th>DUCTILE IRON SUPPORT SPACING (FT.)</th>
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</tbody>
</table>

* REFER TO PARAGRAPH "HORIZONTAL PIPE SUPPORTS: CAST IRON" FOR SPACING OF SUPPORT
** 20 FT. MAX SPACING: MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO THE JOINT BEHIND THE BELL AND AT CHANGE OF DIRECTIONS AND BRANCH CONNECTIONS.
3.5 **HORIZONTAL PIPE SUPPORT: CAST IRON:**

A. Support horizontal cast iron pipe with hanger, or pier, located close to the hub; use one support for each pipe length, or every other joint, whichever is closer.

B. Provide hanger within 18 inches of each elbow, also provide hanger within 18 inches of connection to each piece of equipment.

C. Support hubless and bell and spigot cast iron at every length near fitting or clamp. Where maintenance requirements may impose torque, as at a clean-out, support on both sides of torque point.

3.6 **GUIDES, SLIDES AND ANCHORS:**

A. Provide pipe guides where pipeline movement must be restricted to longitudinal only.

B. Provide slides where pipes supported from below must be able to travel in the direction transverse and longitudinal to the pipe centerline.

C. Provide pipe anchors where shown.

END OF SECTION
SECTION 15260 - INSULATION (HVAC & PLUMBING)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
A. All work covered in this section consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal or acoustic insulation applied to the following systems, piping, equipment, and ductwork.

1.2 DEFINITIONS:
A. Exposed piping and ductwork is that which can be seen when the building is complete without opening or removing access door panels, or ceilings tiles. This also includes all mechanical equipment rooms and pipe tunnels.
B. Concealed piping and ductwork are those elements above ceilings, in chases, interstitial space and pipe spaces. Other piping and ductwork is considered to be exposed.
C. Exterior piping and ductwork is that which is exposed to the weather and/or outside the building envelope. Piping and ductwork protected by overhangs, areaways, etc., exterior to the building envelope are considered exterior.
D. ASJ: All service jacket, white finish facing or jacket.
E. Air conditioned space: Space directly supplied with heated or cooled air.
F. Cold: Equipment, ductwork or piping handling media at design temperature of 60 degrees F or below.
G. FRK: Foil reinforced kraft facing.
H. FSK: Foil-scrim-kraft facing.
I. Hot: Ductwork handling air at design temperature above 60 degrees F; equipment or piping handling media above 105 degrees F.
J. Pcf: Density, pounds per cubic foot.
K. Run-out: Branch pipe connection up to one inch nominal size to a one terminal piece of equipment (fan coil, terminal box).
   1. Flat surface: BTU per hour per square foot.
   2. Pipe or cylinder: BTU per hour per linear foot.
   3. Thermal conductivity (k): BTU per inch thickness, per hour, per square foot, per degree Fahrenheit temperature difference.

1.3 QUALITY ASSURANCE:
A. Products of the manufacturers, herein, will be acceptable for use for the specific functions noted. All materials shall be compatible with the materials to which they are applied, and shall not corrode, soften or otherwise attack such materials in either the wet or dry state.
B. Materials shall be applied subject to their temperature limits. Any methods of application of insulation materials or finishes not specified in detail herein shall be in accordance with the
particular manufacturer's published recommendations.

C. Insulation shall be applied by experienced workers regularly employed for this type work.

1.4 RATING:

A. All insulation shall have composite surface burning characteristic rating as tested by ASTM E 84, UL 723, or NFPA 255 not exceeding:

   - Flame Spread: 25
   - Smoke Developed: 50

B. Composite shall include insulation, jacketing and adhesive used to secure jacketing or facing. All accessory items such as PVC jacketing and fittings, adhesive, mastic, cement, tape and cloth shall have the same component rating as specified above.

1.5 STANDARDS:


1.6 SUBMITTALS:

A. Submittals shall include all materials used, including:
   1. Insulation
   2. Jacketing
   3. Tapes
   4. Hardware
   5. Mastics
   6. Adhesives

B. Submittals shall be formatted to include a list of materials for each service

C. Submittals shall use pages from Midwest Insulation Contractors Association – “Commercial and Industrial Insulation Standards” for defining how insulation materials will be applied.

PART 2 - PRODUCTS

2.1 GLASS FIBER INSULATION:

A. Piping:
   1. Nominal minimum thicknesses are listed in the table at the end of this section. These thicknesses are based on insulation having a thermal resistivity between 4.0 to 4.6 sq. ft.-hr.-F/ BTU-in. on a flat surface resistivity to maintain equivalent insulation value.
   2. Insulation shall be 850 deg. F rated as manufactured by Owens Corning, Manville or Knauf.
   3. Insulation shall have factory-applied, reinforced, flame retardant, vapor barrier jacket equal to Owens-Corning ASJ with self sealing lap. Butt joints shall be taped with field-applied ASJ tape 3 in. wide.
   4. Refer to the table at the end of this section for required pipe insulation thicknesses.
   5. Routed or molded fitting insulation shall be Hamfab.
B. Ductwork (Insulation):

1. Insulation shall be 250 deg. F rated as manufactured by Owens Corning, Manville, Knauf, or Certainteed.
2. Duct Wrap: 2 in. thick, 1.0 PCF with aluminum or FRK facing, having a maximum vapor transmission of .02 perms. Minimum installed "R" value shall be 5.6 with 25% compression.

2.2 CELLULAR GLASS:

A. Piping: Cellular glass insulation conforming to ASTM C552 shall be manufactured by Pittsburgh Corning Corporation.
B. Fitting insulation shall be fabricated shapes of cellular glass.

2.3 ELASTOMERIC CLOSED CELL INSULATION:

A. Tubing and Sheet:

1. Flexible fire retardant closed cell, conforming to ASTM C 534, and ASTM 1056. Thermal resistivity shall be 3.70 sq. ft.-hr-F/ BTU-in. Insulation shall be Rubatex or Armstrong.

2.4 PHENOLIC - FOAMED:

A. Insulation shall be CFC free rigid closed cell insulation with the following characteristics:

1. Nominal density 2.2 PCF  
2. Water absorption (ASTM - C209 - .5% by volume; ASTM D2842 - .10 lb./sq. in.  
3. Vapor transmission .117 per inch  
4. Surface flammability (ASTM E-162) -10  
5. Smoke density (ASTM E-622) flame 100.16  
6. Surface burning (ASTM E-84) 3" thick  
7. Flame spread - 20  
8. Smoke developed - 32

B. Insulation shall be KOOLPHEN-K.

2.5 ACOUSTICAL INSULATION:

A. Acoustically treated metal jacketing shall be Childers Muffl-Jac, sound barrier jacketing.
B. Acoustical lagging shall be Childers Muffle-Lag.
C. Acoustical lining shall be a composite of an absorbing layer of acoustical grade foam, non-ferrous metal septum, and acoustical grade foam.

1. Acoustical properties shall be measured in accordance with ASTM E90, STC classified in accordance with ASTM E413.

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<th>Frequency-Hertz</th>
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<th>1000</th>
<th>2000</th>
<th>4000</th>
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<td>21</td>
<td>28</td>
<td>33</td>
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<td>27STC</td>
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</table>

2. Lining shall be United McGill FMF-P or FVF-P.
3. Lining adhesives shall be United McGill.

2.6 REMOVABLE INSULATION:

A. Removable insulation shall be a factory fabricated assembly by Advance Thermal Systems (708) 595-5150 or Ohio Valley Industrial Services, Inc. (412) 269-0200.

2.7 FINISHES:

A. Re-wettable glass cloth, 9 ounce per square yard, rated for 450 degrees F. Covering shall be J.P. Stevens, or Alpha Maritex.

B. Metal jacketing, smooth .016 in. thick, type T 3003 aluminum with laminated moisture barrier. Jacketing shall be Childers, aluminum roll jacketing with Polykraft moisture barrier. Jacketing shall be embossed "No Asbestos" on a 6 inch spacing.

C. Metal fitting covers shall be two-piece aluminum. Covers shall be Ell-Jac.

D. Foil scrim kraft (FSK) jacket, flame retardant vapor barrier. Jacket shall be Alpha Temp 10651, all service jackets.

E. Fitting covers shall be one piece 20 mil PVC, covers shall be Ceel-Tite 550 PVC-UVR by Ceel-Co. Zeston and Proto are approved equals.

F. Water based latex enamel equal to Armstrong WB Armaflex Finish.

2.8 MISCELLANEOUS:

A. Adhesives:

2. Polyurethane - Foster 81-33.

B. Mastic (Weather Barrier):

1. Foster 35-00 Mastic / Vimasco.
2. Childers Vi-Cryl CP10/11.
3. Vimasco WC-5.

C. Coatings:

1. Foster - Monolar Coating / Vimasco
2. Foster Sealfas 30-36 / Vimasco
3. Foster Tite-Fit 30-56 / Vimasco
4. Pittcote 300

D. Vapor Barrier Sealant: Foster Flextra 95-50

E. FSK tape 3 in. wide, equal to Nashua FSK.

F. Insulpins:

G. Roll on Corner bead (2 in. x 2 in., 26 ga. galvanized steel).

H. Fiber reinforced tape - Nashua 357, or 398.
I. Insulation protection shields - Grinnell fig 167.

J. Rigid insulation inserts - Hamfab.

K. Reinforcing Cloth - Vimasco, Elastafab 894, conforming to ASTM D1668.

L. Bands - .020 in., aluminum, 2 in. wide, embossed continuously with the legend "No Asbestos".

M. Hexagonal Wire Netting - One inch mesh, 22 ga. galvanized steel.

PART 3 - EXECUTION

3.1 GENERAL:

A. Insulation shall be applied to clean and dry surfaces after tests and approvals required by this specification have been completed.

B. On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

D. All pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire stop or fire safing materials are required.

E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required.

F. Size insulation to cover electric heat tracing on piping where it is specified.

G. All clevis type pipe supports shall be sized to fit the outside diameter of the insulation.

H. Insulate valves, fittings, flanges etc. with the same thickness of insulation as specified for piping.

I. Install longitudinal jacketing laps to shed rainwater.

J. Insulate items mounted in ductwork with the same thickness of insulation as specified for ductwork: including air measuring stations, smoke dampers, and automatic dampers.

K. Repair insulation damaged by work under this contract to match existing work or replace damaged portion with insulation specified for new work.

L. Standing seams and other projections in ductwork or casings shall have insulation applied so that at least 2" of insulation will cover such projections.

M. Where ductwork is lined, no thermal insulation is required.

N. Where unlined duct and lined duct connect, the insulation shall overlap lined section at least 6".

O. Piping and ductwork covered with metal or P.V.C. jacketing systems shall have the joints
made to shed water. Laps shall be positioned in the bottom quadrant on horizontal pipe and ductwork.

3.2 HVAC SYSTEMS:

A. Concealed Ductwork:

1. Apply jacketed duct wrap to all concealed ductwork providing conditioned air, or outside air. Insulate return ductwork in non-conditioned spaces and in ceiling spaces below a roof.
2. Pull insulation snug, but do not compress insulation more than 1/4 inch.
3. Secure duct wrap insulation to ductwork using adhesive. Secure insulation on bottom on sides of horizontal ductwork and all sides of vertical ductwork with insulpins welded to duct on 12 to 18 inch centers and with clips slipped over the pins. Apply clips without compressing insulation. Make joints by lapping the facing a minimum of 2 inch and stapling with T-5 flared staples. Vapor - seal with Childers CP-30 Low Odor at all staples, clip locations and other penetrations. Seal joints with 3 inch wide FSK tape.
4. Insulation Thickness:
   a. Inside Thermal Envelope:
      ♦ Supply ductwork - 2 in. thick
      ♦ Outside air ductwork - 2 in. thick
      ♦ Return air ductwork - 2 in. thick
   b. Outside Thermal Envelope (Attic/Crawlspace):
      ♦ Supply ductwork - 4 in. thick - 2 layers
      ♦ Return air ductwork - 4 in. thick - 2 layers
      ♦ Exhaust ductwork - 2 in. thick - 1 layer
      ♦ Outside air - 2 in. thick - 1 layer

B. Exposed Interior Ductwork (Rectangular):

1. Apply insulation board with FRK facing to all exposed ductwork providing conditioned air, or outside air. Insulate return ductwork in non-conditioned spaces.
2. Secure insulation with insulpins (all surfaces) welded to duct on 12 to 18 in. centers and with clips slipped over pins. Seams and joints shall be vapor sealed with 3 in. wide FSK tape. Corners and edges of ductwork shall be reinforced with roll-on corner bead.
3. Seal all break and punctures with vapor barrier sealant and FSK tape.
4. Insulation Thickness:
   a. Inside Thermal Envelope:
      ♦ Supply ductwork - 2 in. thick
      ♦ Outside air ductwork - 2 in. thick
      ♦ Return air ductwork - 2 in. thick

C. Exposed Ductwork (Round):

1. Apply commercial semi-rigid flexible board insulation with FRK facing to all exposed ductwork providing conditioned air or outside air.
2. Secure insulation to ductwork using adhesive. Tightly butt insulation sections together. Longitudinal joint shall be lapped 2 in., stapled and taped. Tape circumferential joints with FSK tape at a 50 percent overlap. Tape entire girth at mid-point between joints.
3. Secure insulation with pins on vertical ductwork and the bottom surface of ductwork. Pins shall be spaced on 12 to 18 in. centers with clips slipped over the pins.
4. **Insulation Thickness:**  
   a. **Inside Thermal Envelope:**  
      - Supply ductwork - 2-1/2 in. thick  
      - Outside air ductwork - 2-1/2 in. thick  
      - Return air ductwork - 2-1/2 in. thick  

D. **Elastomeric:**  
   1. Apply closed cell elastomeric insulation to all pipes, equipment and surfaces listed below.  
   2. Secure insulation with contact adhesive in accordance with manufacturers instructions.  
   3. Insulate fittings and valves with miter cut pieces of insulation same thickness as piping.  
   4. Cooling coil condensate piping - 1 in. thick  
   5. Chilled water run-outs to a terminal device - 1 in. thick  
   6. Covers and caps for all valve stems and operators, gauge cocks, thermometer wells and other appurtenances subject to sweating.  

E. **Finishes:**  
   1. **All Service Jacket/fitting Covers:**  
      a. Exposed piping finish covering indoors shall be the All Service Jacket. Fittings shall be covered with molded fitting covers.  
      b. Concealed Piping finish covering shall be the All Service Jacket. Fittings shall be covered by wrapping the fitting with fiber reinforced tape, with a 5 percent overlap.  
      c. Pipe fittings larger than cataloged aluminum two piece or PVC covers shall be covered with vapor barriers mastic for cold lines, or two layers of hydraulic cement reinforced with wire mesh and finished with vinyl acrylic weather barrier mastic.  
   
2. **Paint:**  
   a. Exposed or exterior installations of elastomeric closed cell insulation shall be painted with two coats of water base latex enamel.  

3.3 **PLUMBING SYSTEMS:**  

A. **Hot Piping and Ambient Temperature Piping with Heat Tracing:**  
   1. See schedule at the end of the section for thickness.  
   2. Each section of insulation shall be firmly butted and secured with ASJ or SSL butt strips a minimum 3 inches wide. ASJ jacket laps and butt strips shall be secured with outward clinch staples at 4 inch spacing (hot piping only).  
   3. All fittings and valves shall be insulated with preformed fiber glass fittings or mitered sections of pipe insulation. Insulation shall be of equal thickness to the adjacent pipe insulation.  
   4. Insulate flanges and unions on electric traced piping, with insulation of same thickness as specified for pipe connected to flanges. Do not insulate flanges and unions or low temperature (below 120 deg. F) water systems.  
   5. Provide rigid insulation inserts per manufacturer's recommendations at each support.  
   6. Provide insulation shield at each support.  
   7. Provide removable insulation on all items requiring service. Which includes:  
      a. Balancing valves  
      b. Pressure reducing valves  
      c. Control valves
8. Provide removable insulation sections equal in thickness to pipe covering.

B. Cold Piping (Cellular Glass Only):

1. Insulate horizontal rain leaders (normal and emergency) in ceiling plenums.
2. Thickness:
   a. All sizes - 1-1/2 inch thick.
3. The insulation shall be applied with all joints buttered full depth with mastic or joint sealant. The insulation sections shall be staggered and tightly butted together, except at contraction joints. Use 2” x 0.015” aluminum bands 12” on center. The mastic or joint sealant shall be white in color.
4. Insulation for fittings, valves, and flanges shall be sized to match adjacent straight run pipe insulation and fabricated from cellular glass. All joints shall be sealed as above. Large voids between the insulation and fitting shall be filled with a polyurethane foam.
5. Insulation shall be covered with field or factory applied All Service Jackets. Overlap on the longitudinal seams shall be sealed with vapor seal adhesive and stapled. Overlap jacket along pipe length and seal with adhesive.
6. Provide at each support a curved insulation protection shield.
7. Cover each staple with vapor seal mastic.

C. Elastomeric:

1. Apply closed cell elastomeric insulation to all pipes, equipment and surfaces listed below.
2. Secure insulation with contact adhesive in accordance with manufacturers instructions.
3. Insulate fittings and valves with miter cut pieces of insulation same thickness as piping.
4. Insulated surfaces:
   a. Roof Drains - 1 in. thick.
   b. Waste piping from electric cooler - 1 in. thick.
   c. Waste piping from ice maker - 1 in. thick.
   d. Cooling coil condensate piping - 1 in. thick.
   e. Waste piping and p-traps from floor drains above ground receiving cooling coil condensate - 1 in. thick.
   f. Covers and caps for all valve stems and operators, gauge cocks, thermometer wells and other appurtenances subject to sweating.
   g. Cold domestic water piping - 3/4 in. thick.
   h. Domestic hot water piping 1 in. and smaller - 3/4 in. thick.

NOTE: Domestic water piping may be insulated with fiberglass also.

D. Finishes:

1. Metal Jacketing (Aluminum):
   a. Cover the following insulated systems with metal jacketing:
      ♦ Exposed piping indoors (all)
   b. Cover with .016 in. thick aluminum jacket and hold in place with 2 in. wide aluminum bands on 9 in. centers. Fittings shall be covered with mitered segments of jackets or two piece preformed fitting covers. Provide angle ring escutcheons at wall, ceiling or floor penetrations.
   c. Machine cut the jacket to produce a straight, smooth edge. Lap longitudinal and circumferential seams not less than 2 in. Install jackets on horizontal piping with the longitudinal seam approximately midway between horizontal...
centerline and the bottom side of pipe. Install with the top edge of jacket overlapping the bottom edge of jacket and with the seam of each jacket slightly offset from the seam of the adjacent jacket. Install jackets on vertical piping and on piping pitched from the horizontal from low point to high point so that the lower circumferential edge of each jacket overlaps the jacket below it.

2. All Service Jacket/fitting Covers:
   a. Exposed insulated piping indoors not scheduled for painting shall be covered with an All Service Jacket. Fittings shall be covered with molded fitting covers.
   b. Concealed Piping finish covering shall be the All Service Jacket. Fittings shall be covered by wrapping the fitting with fiber reinforced tape, with a 5 percent overlap.
   c. Pipe fittings larger than cataloged aluminum two piece or PVC covers shall be covered with vapor barrier mastic for cold lines, for hot lines, or two layers of hydraulic cement reinforced with wire mesh and finished with vinyl acrylic weather barrier mastic shall be used.

3. Paint:
   a. Exposed or exterior installations of elastomeric closed cell insulation shall be painted with two coats of water base latex enamel.

END OF SECTION
### HVAC Minimum Pipe Insulation (Fiberglass)

<table>
<thead>
<tr>
<th>Piping System Types</th>
<th>Fluid Temperature Range</th>
<th>Insulation Thickness for Pipe Sizes *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°F</td>
<td>Run-outs 2*** 1&quot; &amp; Less 13-2&quot; 22-4&quot; 5 &amp; 6&quot; 8&quot; &amp; Larger</td>
</tr>
<tr>
<td><strong>Heating Systems Steam &amp; Hot Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Pressure/Temp</td>
<td>Above 350</td>
<td>1.5 2.5 2.5 3.0 3.5 3.5</td>
</tr>
<tr>
<td>Medium Pressure/Temp</td>
<td>251-350</td>
<td>1.5 2.0 2.5 2.5 3.0 3.5</td>
</tr>
<tr>
<td>Low Pressure/Temp</td>
<td>201-250</td>
<td>1.0 1.5 1.5 2.0 2.0 3.5</td>
</tr>
<tr>
<td>Low Pressure</td>
<td>120-200</td>
<td>0.5 1.0 1.5 1.5 1.5 1.5</td>
</tr>
<tr>
<td>Steam Condensate (or Feed Water)</td>
<td>Any</td>
<td>1.0 1.0 1.5 2.0 2.0 2.0</td>
</tr>
</tbody>
</table>

* For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
** Run-outs to Individual Terminal Units (not exceeding 12 ft. inch length.)

### Plumbing Minimum Pipe Insulation (Fiberglass)

<table>
<thead>
<tr>
<th>Service Water Heating Temperatures °F</th>
<th>Insulation Thickness for Pipe Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-circulating Run-outs **</td>
</tr>
<tr>
<td></td>
<td>Circulating or Heat Traced Mains &amp; Run-outs</td>
</tr>
<tr>
<td></td>
<td>Run-outs up to 2 in.** 2 in and smaller Over 2-1/2 in</td>
</tr>
<tr>
<td>141 - 200</td>
<td>0.5  0.5  1.5  1.5</td>
</tr>
<tr>
<td>100 - 130</td>
<td>0.5  0.5  1.0  1.5</td>
</tr>
</tbody>
</table>

** Run-outs not exceeding 12 ft. in length
<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Insulation Thickness</th>
<th>Heat Loss watts/ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 - 3 in.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4 - 6 in.</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>8 - 12 in.</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>14 - 16 in.</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>18 - 20 in.</td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

NOTE: Do not staple insulation jackets to electric heat tracing lines.
SECTION 15410 - PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The work required under this section includes all work necessary for a complete installation of storm piping and domestic water piping inside the building to 5 feet outside the building, and sanitary waste piping to a point 2 feet, six inches outside the building.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Materials and Methods - Section 15050
B. Supports and Anchors - Section 15140
C. Insulation - Section 15260
D. Natural Gas Piping System - Section 15416
E. Plumbing Specialties - Section 15430
F. Plumbing Fixtures - Section 15440

1.3 SUBMITTALS:

A. Submit schedule of pipe and fittings for each service.

1.4 CODES AND STANDARDS:

A. Standard Plumbing Code

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to design drawings for approximate locations of pipe and for pipe size.

B. Domestic Water Piping:

1. Water piping within building:
   a. 3 inch and smaller shall be copper tube, type "L" hard temper, ASTM B-88.
   b. 4 inch and larger shall be copper tube type "K" hard temper, ASTM B-88.
   c. Piping below ground:
      (1) 2" and larger, type "K" hard temper; ASTM B-88.
      (2) 2" and smaller type "K" soft temper; ASTM B-88.

C. Storm Drainage, Sanitary Waste, and Vent Piping:

1. Above Ground:
   a. Hubless cast iron soil pipe, CISPI Standard 301 with coupling assembly CISPI Standard 310.
   b. Horizontal piping for fixture rough-ins may be DWV copper, ASTM B-306.

2. Below Ground:
   a. Cast iron soil pipe, ASTM A74, tar coated inside and outside with gaskets ASTM C-564.
D. Pumped Waste Piping:

1. Pumped waste piping shall be galvanized steel schedule 40, ASTM A-53 or type "K" copper, ASTM B-88.

E. Fittings - Domestic Water Piping:

2. Mechanically formed tee:
   a. The mechanically formed tee fitting on 2 inch pipe and larger is an acceptable method of installation. All joints created in this manner shall be installed / brazed in compliance with ASME Section IX and the manufacturer=s recommendation. Soft soldered joints shall not be permitted.
3. Wrot Copper, Grooved Type:
   a. Gruvlok Mechanical Pipe Couplings, Figure 7400 Rigidlite Coupling and Figure 7012 Gruvlok Flange, along with Gruvlok Copper Method Wrot Copper Fittings may be used for all tubing, fitting, and component connections. Equal system manufactured by Grinnell and Victaulic is acceptable.
   b. Couplings: Couplings shall be Gruvlok Figure 7400 Rigidlite Coupling. Couplings shall be comprised of a multiple-piece cast metal housing encompassing a separate pressure-responsive design elastomer gasket. The assembly will be joined together with bolts and nuts.
      (1) Coupling Housings: Coupling housings shall be cast in two or more segments of ductile iron in accordance with ASTM A-536 (Grade 65-45-12).
      (2) Gaskets: Shall be a pressure responsive design molded of synthetic elastomer as designated by ASTM D-2000 and shall conform to coupling housing and pipe outside diameter. Gasket shall be Grade “E”, EPDM, marked with green color code identification for service temperatures from -40 degree F to +230 degree F.
      (3) Bolts and Nuts: Bolts shall be heat treated carbon steel oval-neck track bolt conforming to ASTM A-183 with a minimum tensile strength of 110,000 psi. Nuts shall be carbon steel heavy hex nut design conforming to ASTM A-563. Bolts and nuts shall be zinc electroplated in accordance to ASTM B-633.
   c. Flanges: Shall be Gruvlok Flange cast in ductile iron in accordance with ASTM A-536 with zinc electroplated latch bolt closure. Fig. 7012 Gruvlok flange shall conform to ANSI Class 125 cast iron and Class 150 steel flange bolt hole pattern.
   d. Fittings: Fittings shall be Gruvlok Copper Method Full Flow Wrot Copper with ends formed to Gruvlok Copper-Pre Roll Groove specifications to accept Gruvlok Figure 7400 Rigidlite Coupling or Figure 7012 Gruvlok Flange.
      (1) Fitting Material: Shall be copper in accordance with ASTM B-75 and ANSI B-16.22, Alloy C12200.
      (2) Stainless steel pipe and tubing systems.
4. When stainless steel pipe is used, mechanical couplings and grooved fittings will be used.
   a. Style 77-S Coupling:
      (1) Housing: Type 304 stainless steel, conforming to ASTM-A-743, Grade CF-8.
      (2) Standard Gaskets Grade E.
   b. Bolts/Nuts: Type 304 stainless steel, hex-head machine bolts per ASTM A-193, Grade B-8, Class 2.
   c. Fittings: Type 304 stainless steel. Full flow conforms to ASTM A-403. Manufactured by Victaulic or approved equal.

F. Fittings - Storm, Sanitary Waste and Vent Piping:

1. Above ground:
   a. No hub cast iron soil pipe fittings with coupling assembly CISPI Standard 310.
2. Below ground:
   a. Cast iron soil pipe fittings ASTM B-74, tar coated inside and outside.
   b. Schedule 40 PVC-DWV, ASTM D-2855 using solvent cement ASTM D-2564
G. Unions:
1. Solder unions shall be wrought copper, with copper ground joint. ASTM B75, ANSI B16.22.
2. Di-electric, EPSO, 250 lb. WOG.

H. Solder:
1. Solder Metal shall conform to ASTM B32-alloy grade 95TA: 95 percent tin, 5 percent antimony. Joints shall be made with approved solder containing not more than 0.2 percent lead.

I. Valves:
1. To be manufactured to the following Specifications:
   a. Bronze:
      (1) Gate, Globe, Angle & Check - MSS-SP-80
      (2) Ball - MSS-SP-110
   b. Iron:
      (1) Gate - MSS-SP-80
      (2) Globe - MSS-SP-85
      (3) Check - MSS-SP-71
2. Approved Domestic manufacturers: Hammond, Nibco, Apollo, Milwaukee, or approved equal.
3. Valves should be installed according to manufacturer’s recommendations.
4. Valves 3 inches and smaller shall be equal to Hammond 8501, full flow ball type valve with bronze body, solid chrome plated ball and bronze threaded ends, Adjustable packing nut threaded to body, 600 psi WOG or Hammond 8511 in copper lines.
5. Valves 4 inches and larger shall be equal to Hammond IR iron body, bronze trim, gate valve, IBBM, OS & Y, flanged, 200 psi WOG.
6. Check valves 3 inches and smaller shall be equal to Hammond IB 904 body, bronze disc, T pattern swing check, threaded ends, 200 psi WOG or Hammond IB 912 copper lines.
7. Check valves 4 inches and larger shall be equal to Hammond IR 1124, IBBM, swing check flanged ends, 200 psi WOG.
8. Globe valves 3 inches and smaller shall be equal to Hammond IR 440, bronze body, bronze disc and stem, malleable iron hand wheel, threaded bonnet, threaded ends, 200 psi WOG, or Hammond IR 418 in copper lines.
9. Globe valves 4 inches and larger shall be equal to Hammond IR 116 iron body, bronze trim OS&Y, flanged ends, 200 psi WOG.

PART 3 - EXECUTION

3.1 GENERAL:
A. All piping shall be routed to conserve building space, be coordinated with items installed by other trades and not interfere with access to or operation of the facility.
B. Provide roof flashings for pipe penetrations through roof, to be installed by roofing contractor. Install roof drains as recommended by manufacturer and such that piping does not carry weight of roof drain.
C. Water piping within building shall be size indicated on plans and risers. In the event no size is shown, pipe size or size required by the Plumbing Code. Piping shall be sloped toward a system drain and toward outlets, to provide for system drain-down. Install piping to prevent direct contact between ferrous and non-ferrous materials. Allow flexibility for expansion in piping.
D. All water piping within building shall be installed on the interior side of building envelope insulation, except where installed under slab. Where installed in attic locations piping shall be insulated and installed low to trusses/structure with the envelope insulation installed on top of the piping. A poly vapor barrier shall be secured over the piping and under the building insulation. Where it is not
physically possible to install the piping within the building thermal envelope, the piping shall be fitted with electric heat tracing for freeze protection.

E. Domestic water piping system shall be tested with potable water at a pressure of 125 psig or 25 psig above design working pressure, whichever is greater for 12 hours. Test shall be conducted with plumbing inspector unless approved otherwise in writing.

F. Water distribution piping shall be disinfected prior to occupancy or system start-up with a chlorine solution 50 ppm. Allow system to stand for six hours minimum, and then exercise all valves to ensure treatment of all branches and components. System shall be flushed with potable water after disinfection and prior to placement into service.

G. Storm drainage and sanitary waste and vent piping shall be tested in accordance with water and air tests as specified in the SBCCI Standard Plumbing Code, in addition to any tests required by the local plumbing official. (10 feet of head with no apparent leaks. Hold for 30 minutes minimum). Flush all gravity piping including floor drains and roof drains prior to turning over to the Owner.

3.2 PREPARATION:

A. All pipes shall be cut square. Ream pipe and tube ends and remove burrs. Clean the ends of pipes to remove oil, grease and oxides.

B. Prepare piping connections to equipment with flanges or unions.

C. All soldered piping and equipment connections shall be properly prepared in accordance with good piping practice. Apply a thin layer of flux to only the male tubing. Rotate into the fitting with one or two revolutions.

D. Where mechanical pipe couplings are used, copper tube shall be prepared according to published Gruvlok Copper-Prep Roll Groove specifications. Gruvlok Copper-Prep Roll Grooves may only be formed using either Gruvlok Model 1040C or Model 1041C Copper Prep Roll Groover.

1. Tube Ends: Shall be clean and free from indentations, projections, burrs, rust, or roll marks in the area from the pipe end to groove.
2. Gruvlok couplings, Gruvlok Copper Method fittings, Gruvlok Flanges, and copper tubing shall be assembled in accordance with instructions for the Gruvlok Copper Method, published by Grinnell Corporation.

E. Where mechanical formed tee connections are used:

1. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. The collaring device shall be fully adjustable as to insure proper tolerance and complete uniformity of the joint.
2. The branch shall be notched to conform to the inner curve of the run tube and dimpled to insure penetration of the branch tube into the collar is of sufficient depth for brazing and the branch tube does not obstruct the flow in the main line tube.
3. All joints shall be brazed in accordance with the Copper Development Association Copper Tube handbook using B-Cup series filler metal. NOTE: Soft soldered joints will not be permitted. Brazing shall include filler metal conforming to AWS A5.8.
4. All mechanically formed branch collar shall be listed by the National Standard Plumbing Code, B.O.C.A., I.A.M.P.O., S.B.C.C., HUD, U.S. Army Corps of Engineers, and Underwriters Laboratory.
5. Where PVC is connected to hubless cast iron the connection must be made with special coupling press to compensate for differences in outside diameters of the two materials.
3.3 INSTALLATION:

A. Domestic Water Piping:

1. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
2. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
3. Provide clearance for installation of insulation and access to valves and fittings.
4. Provide access where valves and fittings are not exposed.
5. Install valves with stems upright or horizontal. Provide drain valves at low points in systems.
6. Test cold water piping before being insulated or concealed in walls or ceiling.

B. Storm Drainage, Sanitary Waste, and Vent Piping:

1. Horizontal soil, waste and drainage lines within building shall have a minimum uniform slope of 1/8 inch per foot on 4 inch and larger, and 1/4 inch per foot on lines 3 inch and smaller.
2. Turns in sanitary, soil, and drain piping shall be made using 45 degree elbows, wyes, quarter-, eighth-, or sixteenth bends, or other bends approved by the Plumbing Code.
3. Do not use sanitary tees or crosses except where discharging from horizontal to vertical.
4. Make changes in pipe sizes with reducing fittings and recessed reducers. Do not reduce line size in direction of flow.
5. Provide cleanouts in all horizontal turns in waste piping greater than 45 degrees.
6. Provide deep seal traps on all floor drains, and trap primers where required by code or as indicated on drawings.
7. Indirect waste lines dumping into floor or hub drains shall maintain a 2-inch air gap between the end of the waste line and the rim of the floor or hub drain.
8. Pumped waste piping shall be installed at slope of 1/8 inch per foot in the direction of flow.

3.4 APPLICATION:

A. Install unions downstream of valves and at equipment or apparatus connections. Install dielectric unions where joining dissimilar materials.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install brackets at cast iron no hub cleanouts to protect the integrity of the joint.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED

A. Aquatic life support and water treatment systems for the Birmingham Zoo Trails of Africa project, including but not limited to:

1. Piping, fittings, supports, and associated equipment
2. Pumps
3. Pressure filter vessels and appurtenances
4. Media for pressure filters
5. Not used
6. Valves and valve actuators
7. Coatings
8. Fiberglass tanks, grates and other fiberglass specialty items
9. Chemical feed systems
10. Pressure gauges and thermometers
11. Miscellaneous mechanical equipment
12. Work shown on drawings identified by sheet numbers beginning with “LS”.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete Work: Division 3.
B. Painting and Coatings: Division 9.
C. Electrical: Division 16.
D. Motors and Motor Control: Divisions 15 and 16.
E. Mechanical Work: Division 15.
F. Trenching, Backfilling and Compaction: Division 2.
G. Coordination of submittals and shop drawings: Division 1.

1.3 DEFINITIONS

A. As used in this Section, the following abbreviations are understood to have the following meaning:

  AASHTO       American Association of State Highway and Transportation Officials
  ACS           Automated control system
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>BWD</td>
<td>Backwash drain</td>
</tr>
<tr>
<td>CFM</td>
<td>Cubic feet per minute</td>
</tr>
<tr>
<td>Degrees F</td>
<td>Degrees Fahrenheit</td>
</tr>
<tr>
<td>FMVSS</td>
<td>Federal Motor Vehicle Safety Standard #302</td>
</tr>
<tr>
<td>FRP</td>
<td>Fiberglass reinforced polymer</td>
</tr>
<tr>
<td>FT</td>
<td>Feet</td>
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<tr>
<td>GPM</td>
<td>Gallons per minute</td>
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<tr>
<td>HP</td>
<td>Horsepower</td>
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<tr>
<td>HVAC</td>
<td>Heating ventilation and air conditioning</td>
</tr>
<tr>
<td>ID</td>
<td>Inner diameter</td>
</tr>
<tr>
<td>Kwh</td>
<td>Kilowatt hours</td>
</tr>
<tr>
<td>GAL</td>
<td>Gallon</td>
</tr>
<tr>
<td>LSM</td>
<td>Life support makeup</td>
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<tr>
<td>MM</td>
<td>Millimeters</td>
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<tr>
<td>No.</td>
<td>Number</td>
</tr>
<tr>
<td>NUSIG</td>
<td>National Uniform Seismic Installation Guidelines</td>
</tr>
<tr>
<td>NPT</td>
<td>National pipe thread</td>
</tr>
<tr>
<td>PPM</td>
<td>Parts per million</td>
</tr>
<tr>
<td>PSIG</td>
<td>Pounds per square inch gauge</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl chloride</td>
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<tr>
<td>PVC (LXT)</td>
<td>Low extraction PVC</td>
</tr>
<tr>
<td>PWF</td>
<td>Packaged water filter</td>
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<tr>
<td>RPM</td>
<td>Revolutions per minute</td>
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<tr>
<td>SCFM</td>
<td>Standard cubic feet per minute</td>
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<tr>
<td>SCFH</td>
<td>Standard cubic feet per hour</td>
</tr>
<tr>
<td>SMACNA</td>
<td>Sheet Metal and Air Conditioning Contractors National Association</td>
</tr>
<tr>
<td>SST</td>
<td>Stainless steel</td>
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</table>
1.4 SUBMITTALS

A. General: Refer to Section 013300 for requirements for submittals.

B. Shop Drawings: Shop drawings are required for all elements of the life support and water treatment systems including, but not limited to, the following items. Shop drawings shall be prepared for all exhibit areas, exhibit tanks, life support rooms and other areas, both above-grade and below-grade, that contain life support and water treatment system equipment and piping. Shop drawings must be approved by the OWNER’S REPRESENTATIVE prior to installation of corresponding elements for this project. The shop drawings shall be a coordinated set prepared and submitted as a single submittal.

1. The CONTRACTOR shall provide ¼-inch scale piping and equipment plans for the life support and water treatment systems. These shop drawings shall indicate the exact location of all life support equipment, pipes, fittings, valves and connections to structures. Elevations of all piping shall be shown on the shop drawings. The shop drawings shall indicate that detailed coordination with all other trades has been performed. These shop drawings shall be prepared for all equipment rooms, exhibit tanks, valve vaults and site piping.

2. Where an approved substitution of life support equipment requires changes in the life support and water treatment system and the adjoining work of any other trade, shop drawings for those changes shall be provided. Modifications required must be fully noted to bring specific attention to all changes required in order to install the approved substitute product.

3. Shop drawings for all fiberglass and PVC specialty items, including skimmer boxes, sumps, pipe supports, weir plates, supports for fiberglass grating, cover plates, etc shall be submitted for review. Shop drawings shall include all related items and accessories indicated on the drawings, including metal components, mounting hardware, etc.

4. Shop drawings of fiberglass pressure filters, fiberglass tanks and all related items and accessories shall be submitted for review. Shop drawings shall include detailed design calculations, bill of materials listing all components, resins, catalysts, promoters, ultraviolet light absorbers, agents, reinforcing materials, etc., with manufacturer’s name, trade and identification marks. The laminate sequence used for all tanks must either be attached to or included on drawings used by the fabricator’s shop personnel.

5. The drawings and data submitted shall include the following:
   a. Dimensions including anchor bolt layouts.
   b. Nozzle schedule including size, mark, thickness, and rating.
   c. Details of all clips and lugs for pipe brackets, pressure gages, and anchor bolts,
as integral parts of the tank.

d. Details of structural support members.

e. Equipment weight, empty and filled with water and media.

f. Laminate sequence of construction and all materials of construction listed.

g. Specifications for all supplied bolting, gaskets, and accessory items.

C. Equipment and Material Submittals: Equipment and material submittals (manufacturer’s detailed technical literature and product data, including equipment capacity) are required for all elements of the life support and water treatment systems, including but not limited to the following items. Equipment submittals must be submitted in detailed succinct packages as listed in the items below. Incomplete submittal packages will not be reviewed and will be returned to the Contractor for resubmittal. Equipment submittals must be approved by the OWNER’S REPRESENTATIVE prior to installation shall be submitted for review of corresponding elements for this project.

1. Pipe materials, pipe fittings and proposed testing procedures.

2. P Valves and valve actuators.

3. Slide gates and miscellaneous piping appurtenances.

4. Fiberglass grating and fiberglass specialties.

5. Pumps, motors and bases.

6. Pressure filters and filter media.

7. Water quality instrumentation (pressure gauges, flow meters, thermometers, etc)

8. Pipe hangers, pipe supports and pipe support shop drawings and calculations.

9. Piping and equipment identification material.

10. Coatings.

11. Heater.

D. Maintenance Data and Operation Instructions: The CONTRACTOR shall prepare (4) sets of the manufacturer’s operations and maintenance materials for the life support equipment including but not limited to that identified below. Three ring binders shall be tabbed and indexed. The materials shall be in the original published form from the supplier (photo copies are not acceptable). One set shall be furnished to the Architect/OWNER’S office as a submittal for a review of completeness. After incorporating corrections or additions to the first set, three complete sets shall be delivered to the OWNER.

1. Valves and valve actuators

2. Pumps and motors

3. Pressure filters
4. Slide gates and miscellaneous piping appurtenances
5. Water quality instrumentation
6. Coatings

1.5 PRODUCT HANDLING

A. Procedure: In accordance with General Conditions.

B. Pressure Filters: After installation and prior to the placing of the filter media, the interior of the tanks shall be inspected and any required repairs shall be made.

C. All equipment and piping shall be shipped, handled, stored, and installed in accordance with the manufacturer’s requirements.

1.6 MAINTENANCE MATERIALS AND SPARES

A. The CONTRACTOR shall provide materials and spare parts as described below:

1. Valves and Valve Actuators:
   a. The CONTRACTOR shall provide one replacement “O”-ring and seal set for every five valves of each type and size. If there are less than five valves of a given size, provide one set for that size. Sets shall be individually packaged and identified.
   b. One complete spare valve actuator for each size and type of actuator.

B. Pumps:
   1. See pump section.

C. Lubricants and Applicators:
   1. One year supply of each type of manufacturer’s recommended lubricant for all mechanical devices provided.
   2. One lubricant applicator for each lubricant provided with appropriate attachments for mating with grease fittings provided.

D. Instrumentation:
   1. One spare element and indicator/transmitter for each size and type of the following instruments:
      a. Pressure gauges and pressure switches
      b. Temperature sensors and indicator/transmitters
      c. Flow meters and indicator/transmitters
      d. Level sensors and indicator/transmitters
      e. Thermometers and thermowells
E. Specialty Maintenance Materials:

1. Provide specialty maintenance materials for equipment where required. Provision of specialty maintenance equipment shall be subject to approval with regard to completeness and relevance.

1.7 QUALITY ASSURANCE

A. Reference specifications and standards:

1. ANSI: A13.1 - Scheme for the Identification of Piping Systems
2. ANSI: B16.5 - Pipe Flanges and Flanged Fittings.
4. ANSI: B16.18 - Cast Bronze Solder Joint Pressure Fittings.
5. ANSI: B16.22 - Wright Copper and Bronze Solder-Joint Pressure Fittings.
6. ANSI: C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
11. ASTM: B62 - Composition Bronze or Ounce Metal Castings.
12. ASTM: B88 - Seamless Copper Water Tube.
15. ASTM: D413 - Rubber Property Tests for Adhesion to Flexible Substrates.
17. ASTM: D638 - Test for Tensile Properties of Plastics.
22. ASTM: D1149 - Test for Rubber Deterioration - Surface Ozone Cracking in a
Chamber.

23. ASTM: D1204 - Test for Linear Dimensional Change of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperature.


26. ASTM: D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

27. ASTM: D2105 - Test for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube.

28. ASTM: D2136 - Coated Fabrics - Low Temperature Bend Test.


37. AWWA: B100 - Standard for Filtering Materials

38. AWWA: C950 - Glass-Fiber-Reinforced Thermosetting-Resin Pressure Pipe.


41. NACE Standard: TM-01-70 - Surface Preparation

B. When two or more of the above regulations are applicable, the more stringent requirement shall be met.

1.8 SEISMIC RESTRAINT
A. All equipment, piping and appurtenances associated with the life support and water treatment systems included under this specification and shown on the life support drawings shall be provided with seismic restraint in accordance with all applicable codes for the seismic zone at the project location and the provisions of SMACNA and NUSIG requirements. Where seismic restraints are required, the CONTRACTOR shall provide engineered shop drawings of the proposed seismic restraint system and calculations by a Structural Engineer licensed in the state of the project. If the proposed seismic restraint system and/or its components are part of a recognized, pre-designed system that is part of the NUSIG or SMACNA general requirements and standard details, the CONTRACTOR may provide confirmation with supporting documentation stating such, in lieu of shop drawings.

1.9 ELECTRICAL COORDINATION

A. For all equipment specified herein, the CONTRACTOR shall provide transformers if required to ensure that all equipment will function as specified with the electrical service provided. Refer to the equipment schedules on the drawings for information regarding electrical requirements for the equipment. Transformers shall be provided in accordance with the electrical specifications.

PART 2 - PRODUCTS

2.1 PIPING

A. General:

1. The CONTRACTOR shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, valves, accessories, insulation, coating and testing, to provide a functional installation.

2. The CONTRACTOR shall submit complete shop drawings and certificates, test reports and affidavits of compliance for all piping systems. The shop drawings shall be in accordance with the shop drawings section of this specification. All expenses incurred in making samples for certification of tests shall be born by the CONTRACTOR.


a. Inspection. All pipes shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the OWNER in writing of the manufacturing starting date not less than 14 calendar days prior to the fabrication of any pipe.

b. Tests. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. (Welds shall be tested as specified.) The CONTRACTOR shall perform all tests at no additional cost to the OWNER. The OWNER shall have the right to witness all testing conducted by the CONTRACTOR. In addition to those tests specifically required, the OWNER may request additional samples of any material for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

c. Where the assistance of a manufacturer’s service representative is advisable, in order to obtain adequate pipe joints, supports, or special connections, the CONTRACTOR shall furnish such assistance at no additional cost to the OWNER.

d. All piping, materials, fittings, valves, and accessories shall be delivered in a clean
and undamaged condition. All should be stored, if possible, at the job site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to ends of the pipe. Proper facilities shall be provided for lower sections of pipe. Under no circumstances shall pipe, fittings or any other material be dropped or dumped. Pipe should be stored in such a way as to prevent sagging or bending and should be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Regards will be given to any other storage and installation procedures recommended by the manufacturer.

e. All material found to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the work.

f. Pipe, fittings and accessories shall be carefully inspected before and after installation, and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs.

4. Cleanup. After completion of the WORK, all remaining pipe cuttings, joining and wrapping materials, and other scatter debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

5. Backfill of Below-Grade Piping. All below-grade piping shall be backfilled as detailed on the drawings. Refer to LSS Drawing 804. As an option, the contractor may also choose to use cement slurry controlled density fill (CDF) for backfill of below grade piping. The purpose of the CDF is to minimize trench settlement, maintain circular shape of pipe walls, and reduce the time required for installation. The CDF slurry shall be designed by a local concrete supplier according to the following design criteria. The CDF slurry supplier shall ensure that the CDF slurry design is adequate for its intended use. CDF slurry shall meet the following criteria:

a. 28-Day Compressive Strength of 150 to 200 psi
b. 1.5 to 2.0 percent Portland Cement
c. 5 to 15 percent fly ash by weight
d. Aggregate shall be coarse sand or 3/8-inch gravel (max. size)
e. 4 to 6 percent air content to maintain flowability
f. 9 to 10 inches of slump

6. Pressure Rating. Unless otherwise noted, all piping systems, including pipe, fittings and all appurtenances shall be designed for 65 psi minimum working pressure and 100 psi minimum test pressure. All piping systems shall be flushed clean and pressure tested prior to start-up. Where the test pressure exceeds the pressure rating of filter vessels or other pieces of equipment, those items shall be isolated so as to not expose them to excessive pressures.

7. Pipe Flanges:

a. Flanges. All pipe flanges shall be 150-lb. plastic ANSI flanges with full face gaskets. Unless otherwise shown, all flange bolts shall be Type 304 SST. Bolt holes shall straddle the vertical center line. Flanges shall conform to ANSI B16.5 150-lb. class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Flanges for
miscellaneous small pipes shall be in accordance with the standards specified for these pipes.

b. Bolting of PVC flanges shall be in accordance with manufacturer's recommendations and shall not be unduly stressed through the use of excessive torque while tightening bolts. Use of torque wrench will be required.

c. Flange Bolts. All-thread Type 304 SST studs shall be used on all valve flange connections with washers and heavy hex nuts and shall have the words “304 SST” stamped on them. Type 304 SST machine bolts shall be used on all other flanged connections with Type 304 SST washers and hex nuts. Studs and bolts shall extend through the nuts a minimum of 1/4-inch.

d. Flange Gaskets. Gaskets for flanged joints shall be full-faced, 1/8-inch thick EPDM with 60 to 70 Shore hardness. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

e. Penetrations through Hydraulic Structures. Where passing through a wall, floor or ceiling of a hydraulic structure, all pipes shall be provided with a wall flange located at the centerline of the wall as shown on the drawings. Flange shall be glued, welded, or bonded watertight around perimeter of pipe.

f. Penetrations through Non-Hydraulic Structures. Where passing through a wall, floor or ceiling of a non-hydraulic structure, pipes shall be provided with 1-inch thick bead of waterproof polyurethane sealant all around per the drawings and treated to comply with code required floor or wall fire rated assembly or system acceptable to local jurisdiction.

g. Below-Grade Flanges. Below-grade flanges shall only be provided where specifically identified on the drawings. Below-grade flanges in other locations shall not be used without prior approval by the OWNER. All below-grade flanges shall be encased in reinforced concrete. Such concrete encasement shall be integral with the adjoining concrete structures (pools, basins, buildings, etc.)

8. Not Used

9. High Points and Low Points. Unless specifically shown on the drawings, high-points and low-points shall be avoided for all below-grade piping. Where necessary for above-grade piping, high-point vents shall be provided for all high-points and low-point drains shall be provided for all low-points. High-point vents and low-point drains shall be provided in accordance with the drawings.

10. Pipe to Wall Penetration Closures for Non-Hydraulic Below-Grade Structures:

a. Description. Where shown, pipe to wall penetration closures shall be Link-Seal as manufactured by Thunderline Corporation, or equal. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely water-tight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing the possibility of cathodic
reaction between them. All metal hardware shall be Type 304 SST.

b. Wall Opening. CONTRACTOR shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a water-tight joint. Sizing (correct Link-Seal model and number of links per seal) may be obtained through manufacturer's catalog. If outside diameter of pipe is non-standard due to coating, insulation, etc., consult manufacturer factory for engineering assistance and recommendation before proceeding with wall opening detail.

c. Installation. CONTRACTOR shall familiarize his installing personnel with Link-Seal instruction bulletin (packed with each carton) which illustrates the proper procedure for installing and tightening the seal to provide a water-tight pipe penetration. Additional installation requirements are shown on the drawings.

11. Testing. All piping shall be tested after installation per the requirements of Part 3 of this specification section.

B. Polyvinyl Chloride (PVC) Pipe:

1. Unless otherwise shown on the drawings, all piping 12-inches in diameter and smaller shall be Schedule 80 PVC.

2. For interior, above-grade applications only, Schedule 40 PVC pipe may be used in lieu of Schedule 80 PVC pipe for pipes smaller than 12-inches in diameter. Pricing for Schedule 80 PVC piping on above grade applications shall be provided by the Contractor as and add alternate as detailed in Specification Section 01230. Where changes between Schedule 40 and Schedule 80 pipe occur, Schedule 40 PVC pipe shall transition to Schedule 80 PVC pipe using flanges or couplings. In all cases, all PVC pipe and fittings used for penetrations through tank walls and floors (including wall sleeves, water stop rings, flange fittings and couplings) shall be Schedule 80. All PVC piping located in the valve pit prior to the screening basin shall be Schedule 80.

3. PVC piping shall be solvent cemented, rigid pressure pipe made from Class 12454-B (Type 1, Grade 1) compounds with no fillers or re-grounds in accordance with ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785, consistently meeting and/or exceeding the quality assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening and extrusion quality. CPVC piping shall be made from Class 23447 compounds.

4. The pipe shall also meet the frozen drop impact requirements of CSA Standard B137.3 and shall bear the mark of the CSA listing agency.

5. All above-grade schedule 40 PVC pipe shall be coated in accordance with section 2.11 paragraph G2 of these specifications.

6. The pipe shall be manufactured in the USA, using domestic materials, by an ISO9001 certified manufacturer. Standard lengths of pipe sizes 6" and larger shall be beveled at each end by the pipe manufacturer. The pipe shall be marked with the National Sanitation Foundation (NSF) seal of approval for potable water applications, and shall be marked with the manufacturers date code that includes the day, month, year and exact time of manufacture in minutes. All PVC pipe shall be manufactured by Harvel Plastics, Inc. or approved equal.
4. PVC Fittings

a. General:

1. PVC fittings shall be of the same material and schedule rating as the adjoining pipe. PVC material shall be made from Class 12454-B (Type 1, Grade 1) compounds with no fillers or re-grounds in accordance with ASTM D1784.

2. Fittings and fabricated items (headers, manifolds, etc.) shall be designed and installed to carry stresses developed with free-end conditions, without thrust blocking end other external restraint.

3. If fitting dimensions are different than those shown on the drawings, the CONTRACTOR shall be responsible for all piping adjustments to accommodate larger dimensions.

b. Construction:

1. All fittings 12-inches in diameter and smaller shall be molded fittings. Molded fittings shall be of the same material and Schedule rating as the adjoining pipe.

   a. Molded fittings shall be labeled with the name of the manufacturer, part number, size, description, production code and classification.

   b. Molded fittings shall be manufactured by Spears, Dura Plastic, Chemtrol, or approved equal.

2. Large diameter and special fittings:

   a. All fittings with diameters greater than 12-inches shall be considered large diameter fittings. Large diameter and special fittings shall be labeled with the name of the manufacturer, part number, size, description, production code and classification.

   b. Large diameter and special fittings shall be fabricated using injection molded components and shall be certified for potable water service by NSF International. Only a factory fusion/pressure technique that renders a 100 percent homogeneous joint at the miters may be used. Injection molded components shall be of the same or higher pressure rating as that of the fitting. All fabricated fittings shall be reinforced with fiberglass wrapping. Before wrapping with fiberglass, PVC shall be welded, cleaned, and prepared with solvent etch compatible with the external resin.

   c. All fiberglass reinforced fittings shall be free of visible chips, cracks, foreign inclusions, air bubbles, lack of fill-out, delamination and sharp obstructive surfaces as defined in ASTM Standard D 2563.

   d. Large diameter and special fiberglass reinforced fabricated fittings shall be rated for a working pressure of no less than 130 psi with a factor of safety no less than three. In addition, these
fittings shall be rated for full vacuum (-14.7 psig) at 75 degrees F.

e. All sockets shall have an interference fit and minimum socket length equal to one half (½) the nominal size of the adjoining pipe.

f. All change of direction fittings shall not exceed one degree of variance in the specified angle.

g. All fittings shall have specified cut lengths for all components. Maximum overall deviations shall not exceed one half (½) inch.

h. Manufacturers of large diameter and special fittings shall be Spears, Chemtrol, Plastinetics or approved equal.

5. Unless otherwise shown, joints shall be solvent welded in accordance with ASTM D2564 and the fitting manufacturer’s instructions. Use glue with set time as recommended by manufacturer appropriate for joint size and weather conditions.

a. All joints in PVC piping for sodium hypochlorite applications shall use solvent cement suitable for 12.5 percent sodium hypochlorite solution. Manufacturer of solvent cement for sodium hypochlorite applications shall be IPS Corporation, or equal. Product shall be IPS Weld-On 724 for CPVC, or equal.

6. Fabricated headers shall be constructed using accepted hot gas welding techniques. This technique shall include the following steps:

a. Welding edges shall be properly beveled and cleaned to provide area for the welding rod and to permit better adhesion.

b. Section shall be clamped and tack welded to adhere the two surfaces together.

c. Welding rod shall be applied with an accepted welding tip in three applications, cutting the rod after each pass.

d. The finished weld shall be able to withstand working pressure of at least 100 psi.

C. Pipe Supports:

1. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified, or required for a complete and operable piping system, in accordance with the requirements of the Contract Documents. Supports shall be manufactured of Type 304 SST, Type 6061-T6 aluminum, or fiberglass components, as shown and required by these specifications for the complete installation.

2. Pipe supports shall be provided by the CONTRACTOR to resist all wind, seismic, gravity and thrust forces. Calculations shall be provided by the Contractor confirming that the piping support system will resist these loads. Calculations shall be signed and sealed by and licensed engineer in the state of the project. Pipe supports shall be provided by the CONTRACTOR with vibration isolation and seismic bracing as noted on the drawings and within these specifications.

3. Pipe supports shall be capable of supporting the pipe and its contents in all conditions of operation. They shall allow for free expansion and contraction of the piping.
4. Stresses on Equipment. All piping shall be supported to avoid transfer of stresses from piping to equipment, including pumps, filters, heat exchangers, etc.

5. Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR at no additional cost to the OWNER. All supplementary members shall be in accordance with the requirements of the building code, the specifications, and the American Institute of Steel Construction.

6. Support Spacing. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping, with special consideration given where components, such as flanges and valves, impose concentrated loads. Vertical supports shall be spaced to prevent the pipe from being over stressed from the combination of all loading effects. Where calculations are not made or more stringent requirements from pipe manufacturers do not prevail, suggested maximum spacing of supports are given in the tables below.

   a. Support Spacing for Schedule 80 PVC Pipe.

      | Pipe Size | Suggested Max. Span * (@ 100 degrees F) feet |
      |-----------|---------------------------------------------|
      | inches    | feet                                        |
      | 1/2       | 4                                           |
      | 3/4       | 4.5                                         |
      | 1         | 5                                           |
      | 1-1/4     | 5.5                                         |
      | 1-1/2     | 5.75                                        |
      | 2         | 6.25                                        |
      | 3         | 7.5                                         |
      | 4         | 8.25                                        |
      | 6         | 10                                          |
      | 8         | 11                                          |
      | 10        | 12.25                                       |
      | 12        | 13.25                                       |

   * Table indicates the maximum support spacing based on the pipe manufacturer’s requirements. The load bearing capacity of the individual pipe anchors and supports may dictate decreased support spacing intervals. Do not exceed the manufacturer’s rated load capacity for the anchors and supports.

7. Pipe hangers. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressers. All hanger rods shall be subject to tensile loading, only.

8. Hangers Subject to Horizontal Movements. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot deflection of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

9. Riser Supports. Risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
10. Freestanding Piping. Free-standing pipe connections to equipment, like chemical feeders, pumps, etc., shall be firmly attached to pipe supports anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded angles and U-bolts or clamps, securing the pipes.

11. Lateral Bracing. All piping (including horizontal and vertical runs of pipe, risers, freestanding piping, etc.) shall be laterally supported to the nearest structural members to prevent movement of the pipes due to thrust loads, seismic loads, wind loads, surge forces, transient conditions, equipment vibration, equipment start-up and shut-down and all other operating and environmental conditionals that may induce movement of the pipes and/or piping system.

12. Submerged Supports. All submerged piping shall be supported with hangers, brackets, clips, or fabricated supports. All materials for submerged supports shall be FRP utilizing vinyl ester resin (Derakane 411, Atlac 382 or equal). Anchor bolts for submerged supports shall also be FRP utilizing vinyl ester resin. Submerged supports shall be designed to resist buoyant forces as well as all gravity, seismic and thrust forces.

13. Point Loads. Any meters, valves, heavy equipment, and other potential point loads on PVC, fiberglass, and other pipes, shall be supported on both sides, according to manufacturer’s recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on plastic and fiberglass piping shall be equipped with extra wide pipe saddles or aluminum shields.

14. Fiberglass pipe hangers and clamps shall be contact molded fiberglass. The reinforcing material shall consist of bi-directional glass cloth approximately 65 percent of the laminate by weight with a synthetic surface weir for maximum resistance to corrosion. The hanger system will conform to ANSI B31.3 for static loading. Hanging rods shall be Type 304 stainless steel. Manufacturer of fiberglass pipe support systems shall be Aikinstrut, IMCO Reinforced Plastics, Super Strut, or approved equal.

15. Flexible Pipe Connectors.
   a. To provide flexibility in the piping system, flexible pipe connectors shall be provided at locations as noted on the drawings.
   b. Flexible pipe connectors are to be double-arch neoprene expansion joint/connector with flanged ends.

D. Piping Identification Systems:
   1. The CONTRACTOR shall furnish, mark, and install identification devices for all exposed piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices, and all appurtenant works, all in accordance with the requirements of the Contract Documents.
   2. Reference Specifications, Codes, and Standards.
   4. CONTRACTOR Submittals
      a. The CONTRACTOR shall submit samples of all types of identification devices to
be used in the work.

b. The CONTRACTOR shall submit to the OWNER, for approval, a list of suggested wording for all valve tags prior to fabrication.

5. Identification of Piping

a. Identification of all exposed pipe shall be accomplished by color-coding with bands and by lettering as specified herein. Color bands shall either be painted directly upon the pipe or shall be pressure-sensitive adhesive-backed vinyl cloth or plastic tape.

b. Each of the pipe identifications shall consist of 2 color-coded bands, a printed label identifying the name of the pipe, and a flow arrow to indicate direction of flow in the pipe. All labels shall be preprinted on pressure-sensitive adhesive-backed vinyl cloth or plastic tape. Arrows shall be die-cut of the same type of material as the labels.

c. Letter sizes and colors for lettering, arrows, and background shall conform to ANSI A13.1.

d. Preprinted identification devices shall be as manufactured by W. H. Brady Co., Seton Nameplate Corp. or approved equal.

6. Identification of Valves and Short Pipe Lengths

a. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal or plastic tags as specified herein.

b. Metal tags shall be of Type 304 stainless steel with embossed lettering. Plastic tags shall be of solid black plastic laminate with white embossed letters. All tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

7. Valve Tags

a. Valve tags shall be permanently attached to the valve or structure by means of two Type 304 stainless steel bolts or screws or type 304 stainless steel tie wire.

b. The wording on the valve tags shall describe the exact function of each valve, e.g., “FWS to Tiger Exhibit”, “FWR from Lion Marsh”, etc.

8. Pipe Identification

a. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point within approximately 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.

b. Pipe identification shall consist of 4 elements, i.e., 2 color bands, a lettered label, and a directional label. The bands shall be arranged so that the lettered label and the directional arrow are placed between the 2 bands.
9. Identification Schedule

a. Identification Color – The CONTRACTOR shall provide the OWNER with a list of available color choices and shall provide the identifying devices with the colors identified by the OWNER.

b. Application of identifying devices shall conform to the following abbreviations:

<table>
<thead>
<tr>
<th>Fluid Abbreviation</th>
<th>Function and Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>OF</td>
<td>Overflow</td>
</tr>
<tr>
<td>DRN</td>
<td>Drain</td>
</tr>
<tr>
<td>CL</td>
<td>Chlorine</td>
</tr>
<tr>
<td>BWD</td>
<td>Backwash Drain</td>
</tr>
<tr>
<td>BYPASS</td>
<td>Bypass</td>
</tr>
<tr>
<td>FWS</td>
<td>Freshwater Supply</td>
</tr>
<tr>
<td>FWR</td>
<td>Freshwater Return</td>
</tr>
<tr>
<td>FWMK</td>
<td>Freshwater Make-Up</td>
</tr>
<tr>
<td>PW</td>
<td>Potable Water</td>
</tr>
<tr>
<td>HXR</td>
<td>Heat Exchanger Return</td>
</tr>
<tr>
<td>HXS</td>
<td>Heat Exchanger Supply</td>
</tr>
<tr>
<td>VNT</td>
<td>Vent</td>
</tr>
</tbody>
</table>

E. Sight Glass Flow Indicators:

1. Sight glass flow indicators shall be provided by the CONTRACTOR in each of the filter backwash drain lines (one per group of filters) and where indicated on the drawings. Sight flow indicators shall be constructed of clear, rigid PVC pipe. The pipe shall be clear Schedule 40 Type II Grade I PVC pipe, and shall be rated for 150 psi. Sight flow indicators shall be a minimum of 12-inches long and shall have flanged connections to the piping system. Sight flow indicators shall be located a maximum of 6 feet above adjoining ground level.

F. Drip Pans:

1. Provide drip pans under piping when installation over or within 5 feet of electrical apparatus is unavoidable or in rooms containing electrical equipment or under drainage piping at ceilings of food preparation areas. Pan shall be reinforced, properly supported and made watertight. Provide enclosed type for pressure piping. Extend 1-1/4 inch drain pipe from pan to spill over nearest floor drain or as indicated. Construction shall be 1/4 inch thick PVC.

2.2 VALVES

A. Thermoplastic Butterfly Valves for Saltwater or Freshwater Service

1. Butterfly valves up to 12-inch diameter.

a. Valves bodies shall be constructed from PVC with ASTM Cell Classification 12454. The operating pressure rating shall be 150 psi for valves up to 10-inch diameter and at least 100 psi for valves larger than 10-inch diameter. The maximum cord length of the valve disc shall be less than the internal diameter of the pipe or flange adjacent to the valve. All metal parts, except stainless steel, shall be factory epoxy coated. Valve bodies shall be constructed in one solid piece. Valve discs shall be constructed of polypropylene or PVC.
1. The CONTRACTOR may use lined, solid thermoplastic butterfly valves for freshwater or saltwater service. Where used, lined butterfly valves shall seal bubble tight with only the liner and disc as wetted parts. Valves with liners shall have double O-ring seals constructed of EPDM on top and bottom of the same material as the valve liner. The liner shall be EPDM, molded and formed around the body, functioning as a gasket on each side of the valve. Valve stem shall be 316 SST and have engagement over the full length of the disc. This type of butterfly valve shall be manufactured by ASAHI/AMERICA (Type 56), Hayward or approved equal.

2. Alternately, the CONTRACTOR may use non-lined, solid thermoplastic butterfly valves for freshwater or saltwater service. All valve seats and O-rings shall be EPDM. Seat shall be a non-liner type interlocked to valve body. Bolt hole patterns shall conform to ANSI/ASME B-16.5 CL 150. Disc shall be offset design with titanium stem or Teflon coated Type 316 stainless steel stem and double O-ring seals. This type of butterfly valve shall be manufactured by Spears Manufacturing Company or approved equal.

3. Metal butterfly valves may be used as an alternate to plastic butterfly valves. Metal butterfly valves shall be wafer style suitable for installation between Class 150 flanges. A replaceable elastomer seat shall isolate the stem and body from the line media.

   a. Valve body shall be epoxy coated ductile iron. Valves up to 12-inches in diameter shall use a two-piece split body design to allow for quick and easy field replacement of the seat, stem and disc. Valves larger than 12-inches in diameter may use a single piece body. Bolts and external hardware for split body valves shall be Type 316 SST.

   b. Discs shall be Type 316 SST with EPDM or Nylon 11 covers. Discs shall not be reduced or undercut.

   c. Shafts shall be Type 316 SST.

   d. Seats, "O" rings, shaft seals and other elastomers shall be EPDM.

   e. Valves shall be suitable for 75 psi minimum operating pressure. Except where lug style valves are required, valves may be wafer style. The cord length of the valve disc shall be less than the internal diameter of the pipe or flange to which it is to be installed.

   f. Exterior Coating. Baked-on fusion epoxy coating or two-part liquid epoxy shall be provided for all exposed metal components associated with the valve in accordance with the protective coatings section of this specification. Epoxy coatings shall be factory applied with a minimum of two coats. The minimum dry film thickness for epoxy coatings shall be 15 mils. Single piece valve bodies may use a nylon coating in lieu of epoxy coating. Coatings may be omitted for SST components. Surfaces shall be prepared as necessary, by sand blasting or other means, to prepare surfaces for application of coatings. All coatings shall be holiday free.

   g. Manufacturer: Keystone Valve (Figure 992 and 999), Bray Valve
(Series 20, 21, 30 and 31), or approved equal

4. Unless otherwise shown, butterfly valves shall be used on pipes larger than 3-inches in diameter.

5. Lug type valves shall be provided on the suction side of pumps, on the discharge side of pumps, on the inlet and outlet sides of heat exchangers and on all filter piping. Lugs shall be Type 304 SST threaded type. Valve bodies shall accept field installable lug inserts or shall be factory installed true lug type.

6. Installation: Where possible, all valves shall be installed with shafts horizontal.

7. Operators:
   a. Manual operators. Manual operators will be installed with each valve unless otherwise stated in contract documents.
      1. Valves 8-in. diameter and larger shall be provided with enclosed weatherproof gear operators with handwheel, position indicator and travel stops. Gear operators shall be equipped with high impact polypropylene or epoxy coated handwheel. Gear box shall be aluminum alloy with epoxy coating. Gear shaft and all other metal hardware (other than epoxy coated gear box and handwheel) Type 304 SST.
      2. Valves smaller than 8-in. diameter shall be provided with Type 304 SST or polypropylene handle type lever operators with polypropylene or SST trigger and positioner for at least 10 positions. All metal hardware shall be Type 304 SST.
      3. All valves located 6 feet or more above the operating floor or platform shall be provided with a chain operator. Gear portion of chain operators shall be the same as for handwheel-type gear operators specified above. Chain operator, sprocket and chain guide shall be aluminum alloy or ductile iron. Chains shall be Type 304 SST.

8. All thermoplastic butterfly valves in the same size category (up to 12-inch diameter and larger than 12-inch diameter) shall be provided and manufactured by the same manufacturer. The manufacturer shall have at least five installations in similar saltwater aquatic applications for each size and type of valve provided. Each installation shall have been in operation for a period of at least two years.

9. Electrical Valve Actuators:
   1. General:
      a. The torque rating for each valve actuator shall exceed the torque recommended by the valve manufacturer by a minimum of 25 percent. Torque requirements shall include the torque required to open the valves from the fully closed position. Design pressure for calculating required actuator torque shall be based on a minimum of 75 psig differential pressure across the valves.
      b. External quick disconnects for both control wiring and power shall be provided for all valve actuators.
c. All hardware required for mounting valve actuators to valves (including but not limited to mounting blocks, valve stem extensions, valve shaft couplings, and intermediate supports) shall be provided. Such hardware shall be constructed of Type 316 SST.

d. The electrical requirements for the control signals and power supplies shall be as required by the automated filter backwash control system.

2. Electric Valve Actuators for Butterfly Valves and Three-Way Ball Valves:

a. Electric actuators shall consist of a reversible type electric motor with compound epicyclic gears or standard gears. The electric actuator shall have a visual mechanical indication, showing output shaft and valve position.

b. The actuator shall have an integral terminal strip which, through conduit entry, will ensure simple wiring to power supplies. Where required for manual override, external quick disconnect assembly including locking type plugs and connectors for both control wiring and power shall be provided. One end of the external disconnect shall be factory pre-wired to the actuator. Both sides of the plugs and connectors shall be provided by the actuator manufacturer. The quick disconnect assembly shall be provided with EPDM dust seal surrounding the code and shall be suitable for wet and corrosive environment. The quick disconnect assembly shall be UL listed.

c. All exposed materials shall be as specified herein and constructed of corrosion resistant materials suitable for continuous long-term operation in a saltwater, marine environment. All external hardware, including bolts, screws, washers, nuts, and other hardware, shall be Type 316 SST. The housing for the electric actuators shall be rated NEMA 4X and shall be constructed of a composite non-metallic materials (if available) or provided with a durable, corrosion resistant coating in accordance with these specifications.

d. Electric actuators shall be provided with over-torque protection and over-torque limit switches. The motors shall be fitted with thermal overload protection.

e. Gears shall be constructed of bronze alloy or steel. Plastic gears are not acceptable.

f. Modulating electric actuators shall be 100 percent continuous duty. Non-modulating electric actuators shall be rated for minimum 50 percent duty cycle. All valve actuators shall have an integral de-clutchable manual override with circular wheel type handle. Manual overrides shall remain disengaged without operator attention until such time as they are manually reengaged. If necessary, an electrical disconnect switch may be provided with the actuator to achieve this requirement. If these switches are used, each switch shall be packaged, mounted, and wired integral to the actuator such that no external wiring, mounting, or other work would be required to provide the specified function. Levers or latches shall not be required to engage or disengage override. Mechanical travel stops shall be included and be adjustable for actuation of 1/4 turn valves. Actuators shall be UL listed and shall bear UL label. Actuator motors shall be designed for frequent cycling and modulating service.

g. Internal heaters shall be provided to reduce condensation. Power supply to the internal heaters shall be continuous and pre-wired to allow one input voltage source. Alternately, an external breather mounted in the auxiliary conduit through the actuator body would be allowed in lieu of the internal heaters to reduce condensation.
h. Unless otherwise indicated, the electric actuators shall be capable of modulating using command signals from the filter controller. Actuators shall be powered and controlled by 120V AC. CONTRACTOR shall coordinate any additional requirements for control of the actuators, such as additional limit switches for intermediate valve positions, based on the ACS design and control strategy. Dry contacts shall also be provided for remote sensing of all opened and closed valve positions.

i. Electric actuators for butterfly valves shall be Series 92 or 87 manufactured by Asahi America or approved equal.

10. Slide Gate Valves

1. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer unless exceptions are noted by the engineer.

Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

2. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561, latest edition.

3. QUALITY ASSURANCE: The manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 50 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.

   a. Gates shall be shop inspected for proper operation before shipping.  

   b. The manufacturer shall be ISO 9001 : 2000 certified.

4. SUBMITTALS. The manufacturer shall submit for approval by the purchaser, drawings showing the principal dimensions, general construction and materials used in the gate and lift mechanism.

5. PERFORMANCE

   a. LEAKAGE. Slide gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.05 U.S. gallon per minute per foot (0.60 l/min per meter) of seating perimeter. Under the design unseating head, the leakage for heads of 20 feet (6m) or less shall not exceed 0.1 U.S. gallon per minute per foot (1.25 l/min per meter) of perimeter. For unseating heads greater than 20 feet (6m), the allowable leakage shall not exceed the rate per foot (meter) of perimeter specified by the following equations:

   Maximum allowable leakage
   Gallons per minute per foot of perimeter:
   \[ = 0.10 + (0.0025 \times (\text{unseating head in feet} - 20)) \]

   Liters per minute per meter of perimeter:
   \[ = 1.25 + (0.1025 \times (\text{unseating head in meters} - 6.1)) \]
Example: If we have a gate with 35 feet head, the leakage for the unseating head will be:

\[0.10 + (0.0025 \times (35 - 20)) = 0.1375 \text{ US gpm/ft of perimeter}\]

6. DESIGN HEAD. The slide gates shall be designed to withstand the design head shown in the schedule.

7. SEAL PERFORMANCE TEST. The gate's sealing system should have been tested through a cycle test in an abrasive environment and should show that the leakage requirements are still obtained after 25,000 cycles with a minimum deterioration.

8. PRODUCT

   a. GENERAL DESIGN. Gates shall be either self-contained or non self-contained of the rising stem, non-rising or telescopic stem configuration as indicated on the gate schedule.

   b. WALL THIMBLE. The wall thimble shall be stainless steel and supplied by the gate manufacturer. Refer to the gate schedule for type and applicable locations. Material thickness should be according to the manufacturer's recommendations and be of sufficient resistance to handle the operating forces.

   c. FRAME. The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design suitable for mounting on a concrete wall (CW), concrete wall with extra-wide flange (CWX), round manhole (RM), round manhole with extra-wide flange (RMX), a wall thimble (WT), or a standard flange (SF). The guide slot shall be made of UHMWPE (ultra high molecular weight polyethylene).

   The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the concrete or wall thimble.

   d. SLIDE. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.

   e. GUIDES AND SEALS. The guides shall be made of UHMWPE (ultra high molecular weight polyethylene) and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.

   Side and top seals shall be made of UHMWPE (ultra high molecular weight polyethylene) of the self-adjusting type. A continuous compression cord shall ensure contact between the UHMWPE guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and allow the water to flow only in the opened part of the gate.

   The bottom seal shall be made of resilient neoprene set into the bottom member of the frame and shall form a flush-bottom.

   f. STEM AND COUPLINGS. The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lbs (178 N) effort on the crank or hand wheel.

   The stem shall have a slenderness ratio \((L/r)\) less than 200. The threaded portion of the stem shall have machined cut threads of the Acme type.

   Where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to
the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.

g. For stems in more than one piece and with a diameter of 1¾ inches (45 mm) and larger, the different sections shall be joined together by solid bronze couplings. Stems with a diameter smaller than 1¾ inches (45 mm) shall be pinned to an extension tube.

The couplings shall be grooved and keyed and shall be of greater strength than the stem.

h. Gates having a width greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

i. Stem guides shall be fabricated from type 304L (or 316L) stainless steel. The guide shall be equipped with an UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/r ratio shall not be greater than 200.

j. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

k. Manual operators shall be provided by the gate manufacturer.

All bearings and gears shall be totally enclosed in a weather tight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings.

Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lbs (178 N) on the crank or hand wheel, and shall be able to withstand, without damage, an effort of 80 lbs (356 N).

The crank shall be removable and fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches (381 mm) and the maximum hand wheel diameter shall be 24 inches (610 mm).

l. Self-contained gates shall be provided with a yoke made of structural members or formed plates. The maximum deflection of the yoke shall be 1/360 of the gate's span.

9. Gates supplied under this section shall be Series 20 Stainless Steel Flow Control Sluice Gates as manufactured by H.Fontaine Ltd.

C. Ball Valves

1. PVC Ball Valves

a. All thermoplastic ball valves shall be of a true union design with two-way blocking capability. PVC True Union Ball Valves shall be of a one piece capsule design or one side threaded carrier design and shall include both socket and threaded end connectors. All True Union Ball Valves shall have Teflon seats with elastomeric backing cushions of the same material as the valve seals. Valve seals shall be Viton. Valves shall be designed for a water-working pressure of not less than 150 psi. When in the fully-open position, valves shall have a port diameter not less than Schedule 80 PVC pipe of the same nominal diameter. Unless otherwise indicated on the contract documents, valves 2-inches in diameter and smaller shall be PVC ball valves.

b. PVC ball valves for sodium hypochlorite applications shall be provided with a
vented ball. 1/8-inch diameter vent hole shall be drilled, deburred and installed on the upstream side of the ball. All materials used for PVC ball valves for sodium hypochlorite applications shall be suitable for continuous exposure to 12.5 percent sodium hypochlorite solution.

c. Ball valves shall be provided with both socket and threaded end connections.
d. Manufacturer shall be ASAHI/America (Type 21), Spears Manufacturing Company (2000 Series), George Fischer (Type 346), Hayward, or approved equal.

D. Check Valves for Water Service

1. Check valves shall be the wafer swing type, externally spring loaded, and size as indicated. Check valves shall be rated for a pressure of 150 psi. Where indicated, check valves shall also be provided with external weight system.

2. Materials:
   a. Body, disc spring and trim: Type 316 SST.
   b. Seat: EPDM.

3. Check valves for water service shall be manufactured by Cla-Val, Keystone Figure 813, Eagle Valve Series 20, or approved equal.

E. Plug Valves

A. General. Eccentric plug valves shall be of the non-lubricated, eccentric type with resilient faced plugs and screwed, flanged or mechanical joint ends as shown on the plans. Port areas of 4-20 inch valves shall be at least 80% of full pipe area. Port areas of 24 inch and larger valves shall be at least 70% of full pipe area. Valves shall have a 150 psi minimum rating and shall provide a drip tight shutoff for pressure in either direction. Valve flanges shall be faced and drilled in accordance with ANSI B16.5, Class 150. Flanges of valves through 12 inches shall have face-to-face dimensions of standard gate valves.

B. Materials and Construction. Bodies shall be of cast iron conforming to ASTM A 126, Class B. Seats in 3 inch and larger valves shall have a welded-in overlay of 90 percent nickel alloy, or Monel, conforming to ASTM B 127. Valves shall be furnished with permanently lubricated, replaceable bearings in the upper and lower plug stem journals. Valves through 36 inches shall have 316 stainless steel bearings. Resilient plug facings shall be of chloroprene (neoprene) material suitable for use with water or sewage, and shall be bonded to a semi-steel core. Packing shall be nitrile-butadiene, multiple V-ring type, externally adjustable and replaceable without removing the bonnet or actuator from the valve, and repackable under pressure. All exposed nuts, bolts, springs and washers shall be zinc plated, except for buried or submerged applications, when they shall be stainless steel.

C. Manual Operators. Unless otherwise indicated within the CONTRACT DOCUMENTS, valves with manual operators (excepting corp cocks and miscellaneous small valves) shall conform to the following requirements:

1. Operators shall clearly indicate valve position and shall close valve when rotated in a clockwise manner. Operators shall be fully enclosed and designed to produce the required torque with a maximum pull of 80 lbs on handwheels or levers and to withstand a maximum input of 300 ft-lbs at extreme actuator positions without...
damage. Actuators shall be sized based on the pressure class of the valve and a full open velocity of 16 feet per second for butterfly valves and 36 feet per second for other valves.

2. Exposed nuts, bolts and washers for above grade installations shall be zinc plated, for below grade and submerged installations they shall be 316 stainless steel.

3. Quarter turn valves 2-inches and smaller installed between floor level and five feet above shall be supplied with lever wrench operators.

4. Quarter turn valves 3-inches and larger and all multi-turn valves installed between floor level and five feet above shall be provided with a cast iron hand wheel. Worm gear or travelling nut operators shall be supplied for quarter turn operators in this configuration.

5. All buried valves shall be provided with a 2-inch square operating nut, extension stems, and valve well, as required below. Buried or submerged quarter turn valves shall be supplied with worm gear or travelling nut operators properly sealed to operate continuously under 35 feet of external water pressure. [Operating nuts on submerged valves shall be 3-inches long.]

6. Valves located more than 5 feet above the finished floor or operating platform shall be equipped with chain wheels, sprockets, and galvanized steel chain extending to three feet above the operating floor. Worm gear or travelling nut operators shall be supplied for quarter turn operators in this configuration. Operator shaft and the gear quadrant shall be supported on permanently lubricated bearings.

7. Exhibit drain valves will be supplied and installed with manual gear lockout device.

D. Epoxy Coating. Valve and operator shall be epoxy coated as specified in part 2.1 of this section, except coating shall have 12 mil thickness.

E. Manufacturer. Eccentric plug valves and actuators shall be Series 100 as manufactured by DeZurik of Sartell, Minnesota; or equivalent.

F. Solenoid Valves

1. Solenoid valves shall be of the size shown and shall be designed for not less than 150 psi water-working pressure. Solenoid valves shall have Type 316 SST bodies and trim. Spring shall be Type 301 or Type 316 SST. Seats and seals shall be Viton. Enclosures shall be NEMA Type 4X. All coil ratings shall be for continuous duty. Operating voltage shall be as required for connection to the ACS or valve controller. The CONTRACTOR shall provide transformers where required for connection to the electrical service provided at the location of the valve. Solenoid valves shall be manufactured by Burkert Controls (Type 5282), or equal.

2.3 PUMPS

A. General:

1. The CONTRACTOR shall furnish and install all tools, supplies, materials, equipment and labor necessary for the installation, testing, and placing into operation of all pumps and pumping appurtenances, complete and operable, all in accordance with the requirements of the Contract Documents.
2. The provisions of this Section shall apply to all pumps and pumping equipment specified, except where otherwise specified in the Contract Documents.

3. The CONTRACTOR shall assign to a single Supplier full responsibility for the furnishing and functional operation of the complete pump system including the pumps, drives, drive motors, starters and accessories. The designated single supplier, however, need not manufacture more than one part of the unit (pump, or motor and drive), but shall coordinate the design, assembly, testing and erection of the unit(s) as specified herein.

4. Wherever it is specified that a single Supplier shall be responsible for the compatible and successful operation of the various components of any pumping equipment, it shall be understood to mean that the CONTRACTOR shall furnish and install only such pumping equipment as the designated single Supplier will certify is suitable for use with its equipment and with the further understanding that this in no way constitutes a waiver of any specified requirements.

5. All manufactured items provided under this Section shall be new, of current manufacture and shall be the products of reputable manufacturers specializing in the manufacture of such products; such manufacturers shall have had previous experience in such manufacture and shall furnish the names of not fewer than 5 successful installations of its equipment of comparable nature to that offered under this contract.

6. All combinations of manufactured equipment which are provided under these specifications shall be entirely compatible, and the CONTRACTOR and the designated single Supplier shall be responsible for the compatible and successful operation of the various components of the units conforming to specified requirements. Each unit of pumping equipment shall incorporate all basic mechanisms, coupling, electric motor or engine drive and unit mounting. All necessary mountings and appurtenances shall be included.

7. Where two or more units of the same type and/or size of pumping equipment are required, such units shall all be produced by the same manufacturer.

8. All materials employed in the pumping equipment shall be suitable for the intended application; material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

   a. Stainless steel pump shafts and miscellaneous stainless steel parts shall be of Type 316.

   b. All anchor bolts, nuts and washers shall be Type 304 stainless steel unless otherwise specified in individual pumping equipment specifications.

9. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated on the Drawings, unless otherwise approved by the OWNER.

10. Alignment. Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft run-out, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.

11. Lubricants. The installation work shall include furnishing the necessary oil and grease for
initial operation.

12. All exposed materials (except stainless steel components) that have not been shop painted, shall be field coated as specified in the Protective Coatings section of this specification. Shop painted items that suffered damage to the shop coating shall be touched up as specified in said Protective Coating Section.

13. Motor Starters, HOA Switches and Disconnects. Motor starters, HOA switches and disconnects shall be provided in accordance with the mechanical and electrical drawings and specifications.

14. Vibration Isolation. All horizontal and vertical pumps, with the exception of plastic pumps with integral strainers, shall all be provided with vibration isolators to eliminate transfer of vibration from the pumps and motors into the floor slab and associated structure.

15. Pump Appurtenances:

a. Flexible Pump Couplings. Flexible couplings shall be provided at all pump suction and discharges for all pumps except plastic pumps with integral strainers. Flexible couplings shall be single arch type with EPDM elastomer material and Type 304 SST backing rings. In all cases, concentric reducer type couplings shall be used to transition to the larger pipe sizes for suction and discharge piping. Type 304 SST thrust rods shall be provided for thrust restraint. Flexible pump couplings shall be manufactured by Red Valve, Dynex, or equal.

b. Nameplates. Each pump shall be equipped with a stainless steel nameplate indicating rated head and flow, impeller size, pump speed, horsepower, and manufacturer’s name and model number.

c. Pressure gauges shall be installed on all pump suction and discharges as shown on the drawings and in accordance with the PRESSURE GAUGES section of this specification.

d. Temporary wire screens shall be provided as described in Part 3.

16. Installation of pumps shall be provided as described in Part 3.

B. Submersible Solids Handling Pumps

1. General: Submersible pumps shall be cast iron or ductile iron suitable for pumping chlorinated freshwater with solids. All mounting hardware shall be non-metallic or Type 304 SST.

2. Impellers: Impellers shall be one-piece, single suction, enclosed two-vane, radial flow type. Impellers shall be designed to pass solids up to a 3-inch diameter solid sphere. Impellers shall be cast iron.

3. Volute: Volute shall be cast iron or ductile iron. Volute shall be one-piece with smooth fluid passages large enough to pass up to a 1.5-inch diameter solid sphere. The volute shall be side flanged with tangential discharge.

4. Sliding Bracket: A sliding bracket assembly shall be provided and shall be attached to the discharge flange of the pump. The sliding bracket assembly shall provide a vertical metal-to-metal seal to the discharge base. This assembly shall be constructed so that the knifing action will provide a self-cleaning, non-clogging, non-sparking UL listed explosion proof assembly when the pump is lowered to the discharge base.
5. Guide Rail System: Two guide rails shall be provided to guide the pump when being raised or lowered and to mount the pump on the discharge base. The rails shall align the pump with the discharge elbow as it is lowered into place. Type 316 SST upper rail guide bracket shall be provided to support and align the rails at the top of the sump. Guide rails shall be Type 316 SST. Single rail or cable guide systems are not acceptable.

6. Discharge Base: The installation shall include a rigid cast iron or ductile iron discharge base. The discharge base shall support the total weight of the pumping unit and shall be bolted directly to the floor of the sump. The discharge base shall incorporate a 90-degree elbow with a 125 lb. ANSI flange discharging vertically for connection to the discharge piping.

7. Lifting Cable: A heavy-duty Type 316 SST lifting cable shall be provided. Cable shall be a minimum of 10-feet long and shall have adequate strength to lift the entire pump and motor assembly.

8. Motor: Pumps shall be driven by completely sealed, electric submersible squirrel cage induction motors. Submersible equipment shall be UL listed for Class 1, Division 1, Groups C and D explosion-proof hazardous locations as defined by the National Electric Code. All electrical parts shall be housed in a sealed oil-filled cast iron, watertight enclosure. Motor shaft shall be one piece Type 316 or 416 SST. Rotor is to be dynamically balanced to meet NEMA vibration limits. All external hardware shall be stainless steel. Cable leads are to enter at the top of the motor and are to allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires are to be double sealed as they enter the motor in such a manner that cable-wicking will not occur. A cable strain relief mechanism shall be included with the sealing system. Motor shall be supplied with 10 feet of power cable and control cable. Power and control leads shall be terminated on a sealed terminal board.

9. Seals: Pumps shall be provided with two separate tandem-mounted mechanical seals to prevent the pumped liquid from entering the rotor/stator cavity. Mechanical seals shall have stainless steel and Buna-N components with carbon-ceramic faces.

10. Moisture Protection: Two moisture protection probes shall be installed to detect moisture in the seal or stator cavity. Probes shall be wired internally to the control cable connection at the top of the motor.

11. Bearings: The pumps shall rotate on an oil lubricated thrust bearing and oil lubricated radial bearing. L-10 bearing life shall be a minimum of 50,000 hours.

12. Thermostats: Thermostats shall be imbedded in the motor windings to protect the motor from overheating. Thermostats shall reset automatically. Excessive heat shall cause the normally closed contact to open, thereby stopping the motor.

13. Float Switches: Each pump shall be provided with a low-level float switch to automatically shut off the pump at low water level in the sump.

14. Model and Manufacturer: Fairbanks Morse Submersible Solids Handling Pump, Model D5430MV or approved equal.

C. Submersible Shredder Pumps

1. General: Submersible pumps shall be cast iron or ductile iron suitable for pumping chlorinated freshwater 330 gpm @ 69 ft max head with solids up to at least 1.5 inch
spherical diameter and to shred solids so they do not clog inside the pump or discharge pipe.

2. Impellers: Impellers shall be dynamically balanced, one-piece, single suction, enclosed double-vane, non-clog impeller made of cast iron. Impellers shall be designed to pass solids up to a 1.5-inch diameter solid sphere. The impeller will have a tungsten carbide cutting tooth brazed to the leading edge tip of the pump impeller vanes.

3. Volute: Volute shall be cast iron. Volute shall be one-piece with smooth fluid passages large enough to pass up to a 1.5-inch diameter solid sphere. The volute shall have a flanged discharge with an ANSI 4-bolt adapter flange.

4. Motor: Pumps shall be driven by completely sealed, electric submersible NEMA B squirrel cage induction motors designed specifically for submersible pump usage and continuous duty of pumped liquid up to 104 degrees F. All electrical parts shall be housed in a sealed oil-filled cast iron, watertight enclosure. Motor shaft shall be one piece Type 304 SST. Rotor is to be dynamically balanced. The stator windings and leads shall be insulated with moisture resistant Class F rated for 311 degrees F. Cable leads are to enter at the top of the motor and are to allow the cable-to-motor connection to be accomplished in the field without soldering. All power and control lead wires are to be double sealed as they enter the motor in such a manner that cable-wicking will not occur. A cable strain relief mechanism shall be included with the sealing system. Motor shall be supplied with at least 30 feet of power cable and control cable. Power and control leads shall be terminated on a sealed terminal board.

5. Seals: Pumps shall be provided with two independent mechanical seals to prevent fluid from entering the motor housing. Mechanical seals shall have stainless steel and Buna-N components with silicon carbide and/or carbon-ceramic faces.

6. Moisture Protection: A moisture protection probe shall be supplied with the pump to detect water in the seal oil and transmit a signal to a panel or alarm box. Probes shall be wired internally through the power cord to the alarm.

7. Bearings: The pumps shall rotate on single deep groove row ball bearings, packed with lithium grease for high temperature usage. L-10 bearing life shall be a minimum of 30,000 hours.

8. Thermostats: The motor shall be protected from failure from overheating and from low voltage or high amperage by a separate thermal overload switch installed in the pump cover.

9. Model and Manufacturer: BJM Pump SK series model 37C or approved equal.

2.4 FILTRATION SYSTEMS

A. Strainers

1. In-line Automatic Flushing Basket Strainers

   a. Body, Type 304 Stainless Steel with flanged ends.

   b. Basket perforations shall be 1/8 in. diameter, unless the head loss exceeds 2 psi with no fouling or 4 psi when 50% fouled, in which case alternate openings shall be submitted to the engineer for approval.
c. Basket open area shall be at least 9 times the area of the incoming pipe.

d. Provide spiral-jet rinse nozzle (and fresh water connection with flexible hose and quick disconnect) to allow for strainer cleaning without removing the cover. Flushing port shall discharge to backwash to floor sink.

e. Submit shop drawings prior to fabrication.

f. Acceptable Products:

   (1) Thompson Basket Strainer

   Miller-Leaman Incorporated

   800 Orange Avenue,

   Daytona Beach, Florida; 32114 Phone: (800) 881-0320

B. VERTICAL PROPELLE-WASHED BEAD FILTERS

   1. SUMMARY

   a. This class of fiberglass pressure filters includes vertical filters larger than 32-inches in diameter with a minimum of 63% increase in mixing head diameter from standard design.

   b. General: Fiberglass pressure filters manufactured from hand lay-up and chop mat fiberglass reinforced plastics, including supports, piping, gauges, media and other appurtenances shall be furnished and installed in accordance with the Contract Documents.

   c. Submittals: Contractor shall submit product data sheets and a 1 quart sample of the bead media.

   d. Quality Assurance:

      1. The services of a qualified representative of the manufacturer shall be provided for two days of inspection of the filter installations prior to start-up.

      2. The Owner's Representative shall be permitted access to the plant area at all times during fabrication and shall be notified one week prior to the estimated date of tests and/or inspections. Final inspection and approval shall be obtained prior to shipment unless written waiver is obtained. ASTM D-4097 shall be utilized for quality control of both chop mat and hand lay-up construction.

   2. PRODUCT: PROPELLE-WASHED BEAD FILTER

   a. Materials of Construction: All filter vessels shall be constructed isophthalic polyester resin reinforced with C-Veil or Type E Glass (as chop or sprayed mat) as specified in the Laminate. The polyester resin used for the corrosion barrier shall be resin manufactured with FDA approved ingredients. The structural laminate may be the same resin used for the corrosion barrier or an alternate isophthalic polyester resin. All filter vessel fabrication will conform to NBS PS 15-69, ASTM D4097 (As applicable, this filter is designed for 40 psi in lieu of an atmospheric vessel and the design Safety factor is 5:1), and ASTM C-582 construction standards.
b. Corrosion Barrier Laminate: All internal wet surfaces shall consist of a minimum 100 mils thickness consisting of a surface layer of C-veil with 90 percent resin and 10 percent glass, followed by an inner layer of one layer of 1.5 oz. chopped strand mat with 70 percent resin and 30 percent glass reinforcement.

c. Structural Laminate: The structural laminate shall consist of an isophthalic polyester resin reinforced with Type E Glass (as chop or sprayed mat).

d. Structural Design Pressure: Filter vessels shall be designed for 40 psi working pressure and a 60 psi test pressure.

e. Fittings:

1) FRP threaded nozzles shall be conically gusseted with minimum strength requirements of 1500 ft-lbs of bending and 200 ft-lbs of torque and suitable for connection to PVC pipe

2) Influent and Effluent Fittings: Influent and effluent fittings shall be fiberglass reinforced plastic FIPT. All flow distributor plumbing and diffusers shall be of PVC, ABS or similar construction and shall have threaded connections

f. Vessel Support: The filter vessels shall be supported on an integral skirt, designed and constructed per ASTM D-4097.

g. Filter Design Details:

1) Process Design: The influent diffuser will be designed to distribute the incoming flow at 21 gpm/sq ft to prevent over pressurization of the filter hill.

2) A minimum of 20-inches of bead media shall be provided above the top of the Influent diffuser. The manufacturer will provide sufficient media to fulfill this depth.

   a) Bead Media effective size 3-4 mm
   b) Uniformity Coefficient Less than 1.5
   c) Specific Gravity .92 to .95
   d) Beads shall be composed of high density polyethylene

3) Supply and install automatic backwash controller and motorized valves on each filter to ensure continuous system flow during filter backwash. The backwash valves will be automatically operated in tandem to close influent to the filter while opening bypass flow. The controller shall include a 1-hour to 7-day backwash interval.

4) Each filter shall be installed with a liquid filled pressure gauge mounted on the filter that shall be connected to the influent piping with a scale of 0-30 psi. Also, each filter will be fitted with external plumbing for backwash (recommended by the manufacturer).

5) The manufacturer shall provide a 5-year written structural warranty. All material in contact with the process water shall be of non-metallic construction. All hardware, including lifting lugs, mounting brackets, hold-downs and bolts shall be fiber reinforced plastics or Type 316 stainless steel, titanium or approved substitute.
1. For bead filters and backwash controllers: Aquaculture Systems Technologies, LLC. is the exclusive manufacturer of this patented technology. Aquaculture Systems Technologies, LLC, 108 Industrial Ave, Jefferson, LA 70121, (504) 837-5575 / (800) 939-3659 phone, (504) 837-5585 fax, info@BeadFilters.com e-mail.

2. For tandem valves: Asahi-America.

2.5 FIBERGLASS PRESSURE FILTERS – CLASS B

A. This class of fiberglass pressure filters includes vertical filters 36-inches in diameter and smaller.

B. Each filter package shall consist of a compression molded or filament wound fiberglass filter unit, face piping, injection molded internal distributor and collection manifold, automatic and manual air relief, two pressure gauges, drain port and multi-port valve. Filters shall be furnished with side-mounted connections. Top connections not allowed.

C. All metal components shall be Type 304 SST.

D. Filter media shall be sand as specified for Class A Fiberglass Pressure Filters, above.

E. Manufacturer: Neptune-Benson, Legacy Series; Pentair, Triton II Series; Hayward, Pro Series, or approved equal.

2.6 HEATERS

A. Electric Heaters. Electric heaters shall be provided in accordance with the following specifications:

1. Heaters shall be provided with a Type 304 stainless steel shell, with and adjustable external thermostat and a heater on indicator light. The thermostat shall have a “positive off” provision at the lowest temperature setting.

2. Heaters shall be provided with a factory installed pressure switch that is adjustable to plus or minus 3 psi. The pressure switch shall shut the heater off when the pump is turned off or when there is no flow to the heater. The heater shall also be equipped with a manual reset high limit switch that will turn the heater off in case of overheating.

3. Heaters shall be designed for in-line installation with 1-1/2-inch diameter inlet and outlet connections. Immersion style heaters are not allowed.

4. The maximum allowable pressure drop thru the heaters at the design flow rate (see schematic diagrams) shall be 5 feet of water column.

5. Electric heaters shall be manufactured by Hayward, Model CSPAXI55, or approved equal.

2.7 WATER QUALITY MONITORS, PROBES, SENSORS, INDICATORS AND TRANSMITTERS

A. General: Pressure gauges, thermometers, flow meters, level sensors, level switches, temperature elements, and other water quality instruments shall be provided where indicated on
1. The CONTRACTOR shall be responsible for providing power, including wiring and conduit, to all water quality monitors, probes, sensors, transmitters, etc. in accordance with the requirements for each item and the Automated Control System, which will be provided by others and installed by the CONTRACTOR.

B. Pressure Gauges:

1. Two types of pressure gauges shall be provided for service on freshwater piping as follows: 1) compound vacuum/pressure gauges on pump suctions, and 2) pressure gauges at all other locations. The scales of the pressure gauges shall be -30 inches Hg to 60 psi for compound vacuum/pressure gauges and 0 to 60 psi for pressure gauges. Pressure gauges shall be bourdon tube and socket type. In addition to bourdon tube and socket, all exposed and wetted metal components shall be Type 316 stainless steel. Gauges shall be glycerin filled with features to dampen or eliminate vibration and pulsation.
   a. Where panel mounted, such as for pump suctions and discharges, pressure gauges shall be a minimum of 4-inches in diameter and shall include an enclosure suitable for panel mounting.
   b. Where not panel mounted, pressure gauges shall be a minimum of 2.5 inches in diameter.
   c. Diaphragm seals shall be provided where shown on the drawings. Materials for seals, o-rings, diaphragm, etc. shall be Teflon or Viton and suited to long term to chlorinated water. All exposed and wetted metal components shall be Type 316 stainless steel.

2. Pressure gauges shall be manufactured by Ashcroft, Weksler, VDO Instruments, Marsh Instruments or equal.

C. Thermometers:

1. Thermometers shall be as specified by the mechanical engineer, with the exception that all exposed metallic components shall be Type 316 SST. The scale of the thermometers shall be suitable for the specific process flow stream.

2. Thermometers shall be provided on piping connections using an oversized tee and Type 316 SST well. Locate one thermometer in each of the following locations for each life support and water treatment system and as noted on the drawings: heat exchanger supply piping (HXS), heat exchanger return piping (HXR).

D. Paddle Wheel Flow Sensors, Indicators and Transmitters:

1. Flow sensors shall be provided where indicated on the drawings. Flow sensors shall be paddle wheel type. One self powered flow indicator shall be provided at each flow sensor location. Enclosures for flow indicator shall be weatherproof and suitable for field mounting.

2. Flow sensors shall be insertion type, provided with “wet-tap” assemblies.

3. The flow sensors shall be manufactured by +GF+ Signet, model no. 515 Rotor X with self powered flow indicator, or approved equal.
E. Level Sensors

1. Ultrasonic level sensors shall be provided where indicated on the drawings. Level sensors shall be provided with level monitors and transmitters at each level sensor location and as necessary for connection to associated equipment. Level sensors shall be capable of operating with 115 VAC power supply. Ultrasonic level sensor shall be capable of level detection up to 12 feet.

2. Each ultrasonic level sensor shall be equipped with two latched relays mounted in the head of the unit. Latched relays shall be rated for 250 volts, 10 amps SPDT. Level control functions shall be as indicated on the drawings.

3. Ultrasonic level sensors shall be manufactured by Flowline, or approved equal.

2.8 CANISTER CHLORINATORS

A. Canister chlorinators shall be provided where shown on the drawings and shall be of the size and capacity as is suitable for the exhibit volume and flow rate. Canister chlorinators shall be inline type and shall consist of an erosion tank of heavy wall plastic construction with a threaded lid and O-ring gasket seal. Chlorinator shall be designed for use with bromine tablets or stick or trichlor. For exhibits up to 4,000 gallons chlorinator shall be by Roman Fountains, model RBU-320IL or approved equal. For exhibits greater than 4,000 gallons chlorinator shall be Rainbow Model #320 by Pentair Pool Products.

2.9 FIBERGLASS GRATING

A. Construction. Fiberglass grating shall be of a square pattern with bars at 1-1/2 inches on center. Unless otherwise noted on the drawings, the thickness of the fiberglass grating shall be 1-1/2 inch minimum. All cut edges shall be resealed with a premium vinyl ester resin. Supports shall be spaced as required to ensure that the maximum deflection under a design load of a 250 lb. concentrated load and a 100 psf uniformly distributed load remains less than 3/8-inch. Supports shall be as recommended by the grating manufacturer. Where pedestals are used to support the grating, pedestals shall be fixed-type.

B. Grate shall be molded from standard fiberglass using chemical resistant resins.

C. Fiberglass grating shall be as supplied by Sea-Safe, Chemical Proof Corporation, Chemgrate, Delta Composites, R&B Aquatics (800-259-9812), or approved equal.

2.10 PIPE PENETRATION FIRESTOPPING

A. Related Documents. Drawings and general provisions of contracts, including general supplementary conditions and Division 1 Specification Sections, that apply to any work specified in this section.

B. Description. Work, in general, includes furnishing and installation only those through penetration fire and smoke seals for openings in floors, walls and other elements of construction that are in accordance with ASTM E-814 (ANSI/UL 1479) and ASTM E-119 (ANSI/UL 263).

C. Related Work. Coordinate work of this section with work of other sections (referenced below):

1. Concrete Work.

2. Unit Masonry.

4. Lath and Plaster.
5. Gypsum Drywall.
6. Division 15 and 16 Sections - Mechanical, Electrical and Plumbing work.

D. Quality Assurance
1. Applicator Qualifications: Two years of documented experience installing UL classified firestop systems or industry equivalent.
2. Performance: Materials shall have been tested to provide a fire resistance rating equal to or surpassing that required by the design document.
3. Opening dimensions that are not in keeping with the mechanical drawings will be the responsibility of the sections referenced above for related work.
4. Quantified Toxicity Report: Available upon request from qualified 3rd party test facility.

E. Submittal
1. Shop Drawings. Submit shop drawings, or manufacturer's detail sheets showing each condition that requires a penetration firestop system. These details must be in accordance with the proposed approved system. Details must include materials to be used, anchorage, methods of installation, and relationship to all adjacent construction.
2. Manufacturer's Data. Submit copies of all manufacturer's specification data, recommendations, and installation instructions for each type of material required.

F. Delivery, Storage, and Handling
1. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, grade, and qualification label where applicable.
2. Coordinate delivery and scheduled installation date to allow minimum storage time at site.

G. Materials
1. Provide materials classified by a qualified third party test facility tested in a system to provide fire resistance equal to at least the rating of construction assembly being penetrated.
2. Provide asbestos free materials that comply with applicable codes and have been tested in accordance with ASTM E-814 (ANSI/UL 1479), ASTM E-119 (ANSI/UL 263).

H. Acceptable Manufacturers
1. Products meeting the requirements described above. The following manufacturers are approved; Tremco, 3M, Dow Corning, or equal.

I. Installation Procedures
1. All surfaces to be sealed must be free of dirt, dust, grease, oil, loose materials, rust or other substances that may affect the proper adhesion of the firestopping materials.

2. Surfaces to which penetration firestop materials are applied to must meet or exceed general design requirements, and be acceptable to the materials manufacturer.

3. Install penetration firestop materials as outlined in the UL Fire Resistance Directory, Factory Mutual or other approved test facility's publication or in accordance with the material manufacturer's written instructions.

4. Any openings in floor or wall not described in a test facility's published directory, or outlined in the manufacturer's data sheets must be firestopped in a manner that meets or exceeds code requirements for that construction.

J. Field Quality Control. All penetration firestop systems should be examined by an appointed Code Official, and the General CONTRACTOR, to ensure proper installation. All systems should remain accessible until all and any inspections have been completed.

K. Adjusting and Clean Up. Remove equipment, materials and debris, leaving the area in an undamaged and clean condition.

L. System Types. Use a system that best matches the wall and floor construction or refer to the manufacturer's published literature.

2.11 PROTECTIVE COATINGS

A. The WORK of this Section shall include the protective coating of all surfaces including all surface preparation, pretreatment, coating application, touch-up of factory-coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

B. The following surfaces shall be protective coated hereunder unless shown or specified herein, or elsewhere in the Contract Documents.

1. Electric motor housings
2. Ferrous metal pump housings
3. Piping and appurtenances
4. Fiberglass tanks
5. Miscellaneous ferrous metal surfaces

C. Reference Specifications, Codes, and Standards:

1. References herein to “SSPC Specifications” or “SSPC” shall mean the published standards of the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.

2. References herein to “NACE” shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.

3. Commercial Standards
a. ANSI A13.1 Scheme for Identification of Piping Systems
b. ANSI/AWWA D102 Painting Steel Water-Storage Tanks

4. Federal Specifications
   a. TT-P-28F Paint, Aluminum, Heat Resisting (1200F)

D. Quality Control:

1. Inspection Services. The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry film thickness of protective coatings. Dry-film and wet-film thickness gauges shall be made available for the OWNER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall provide the services of a trained acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the OWNER.

2. Holiday Testing. The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, or other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
   a. Coatings with Thickness Exceeding 20 Mils. For surfaces having a total dry film coating thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20 or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
   b. Coatings with Thickness of 20 Mils or Less. For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or approved equal shall be added to the water prior to wetting the detector sponge.

3. Film Thickness Testing. On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

4. Surface Preparation. Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

5. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable to or associated with the manufacturer's products furnished under this Contract or the application thereof.

6. Warranty Inspection. A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a
representative of the coating material manufacturer shall attend this inspection. All
defective work shall be repaired in accordance with these specifications and to the
satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR,
reschedule the warranty inspection, or may cancel the warranty inspection altogether. If
a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities
under the Contract Documents.

E. Products - General:
   1. Definitions. The term "paint", "coatings", or "finishes" as used herein, shall include
      surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective
      coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer,
      intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
   2. General. Coating materials shall be sealed in containers that plainly show the designated
      name, formula or specification number, batch number, color, date of manufacture,
      manufacturer's directions, and name of manufacturer, all of which shall be plainly legible
      at the time of use.
   3. The CONTRACTOR shall use coating materials suitable for the intended use and
      recommended by their manufacturer for the intended service.
   4. Compatibility. In any coating system only compatible materials from a single
      manufacturer shall be used in the work. Particular attention shall be directed to
      compatibility of primers and finish coats. If necessary, subject to the approval of the
      OWNER, a barrier coat shall be applied between existing prime coat and subsequent
      field coats to ensure compatibility.
   5. Colors. All colors and shades of colors of all coats of paint shall be as selected or
      specified by the OWNER. Each coat shall be of a slightly different shade, to facilitate
      inspection of surface coverage of each coat.
   6. Protective Coating Materials. Products shall be standard products produced by
      recognized manufacturers who are regularly engaged in production of such materials for
      essentially identical service conditions. Where requested, the CONTRACTOR shall
      provide the OWNER with the names of not less than 10 successful applications of the
      proposed manufacturer's products demonstrating compliance with this specification
      requirement.
   7. The cost of all testing and analyzing of the proposed substitute materials that may be
      required by the OWNER shall be paid by the CONTRACTOR. If the proposed
      substitution requires changes in the contract work, the CONTRACTOR shall bear all such
      costs involved and the costs of allied trades affected by the substitution.

F. Material Sources: Each of the following manufacturers is capable of supplying many of the
   industrial coating material specified herein. Where manufacturers and paint numbers are listed, it
   is to show the type and quality of coatings that are required. Proposed substitute materials must
   be shown to satisfy the material descriptions and to equal or exceed the properties of the listed
   materials as required above. Manufacturers include Ameron, Carboline Coatings Company,
   Engard Coatings Corporation, Glidden Coatings and Resins, Koppers Company, Inc., Pittsburgh
   Paints, Tnemec Company, Valspar Corporation, or equal

G. Coating Systems:
   1. High Solids Epoxy. Amine cured epoxy shall be utilized to coat all aluminum and
      exposed ferrous metal surfaces, including electric motor housings, non-plastic or non-
stainless steel valves and operators, and other metal pump component housings and all other ferrous metal equipment components. High build, amine cured, straight epoxy resin shall have a solids content of at least 80 percent by volume. The material shall conform to Food and Drug Administration regulations for food additives. Surface preparation shall conform to commercial blast cleaning SSPC-SP6.

a. Prime coat and finish coats (3 or more, DFT = 16 mils), Amercoat 395, Engard 480, Tnemec 104, or approved equal.

b. The application of the epoxy coating shall be done after all welding of clips, supports and appurtenances.

2. Acrylic Latex for Exposed, Exterior PVC Piping. Exposed, exterior PVC piping shall be coated with a single component, water based acrylic latex with a fungicide additive shall have a minimum solids content of 35 percent by volume. Prime coat shall as recommended by manufacturer.

a. Prime coat (DFT = 2 mils), as recommended by manufacturer.

b. Finish coats (2 or more, DFT = 6 mils), Amercoat 2104, Carboline 3300, Engard 230, Valspar 79, or approved equal.

c. Total system DFT = 8 mils.

3. Aliphatic Polyurethane for Exposed, Exterior Fiberglass Piping, Structures and Specialty Items. Exposed, exterior fiberglass surfaces shall be coated with a two-component aliphatic polyurethane coating material and shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.

a. Plastic and fiberglass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer. Non-ferrous metal surfaces shall be solvent-cleaned SSPC-SP1 followed by sanding or brush-off blast cleaning SSPC-SP7. All surfaces shall be clean and dry prior to coating application.

b. Prime coat (Tie coat), Amercoat 185, Engard 420, Tnemec P66, or equal.

c. Finish coats (2 or more, DFT = 3 mils), Amershield, Engard 428 HS, Tnemec 73, or equal.

H. Execution:


a. Manufacturer's Recommendation: Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed. The CONTRACTOR shall supply the OWNER with copies of each manufacturer's instructions in accordance with the requirements of Section 01330.

b. All protective coating materials shall be used within the manufacturer's recommended shelf life.
c. Storage and Mixing: Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

2. Preparation for Coating.

a. General: All surfaces to receive protective coatings shall be cleaned as specified herein prior to application of said coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application.

b. Protection of Surfaces Not to be Coated: Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

c. All hardware, lighting fixtures, switch-plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

d. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

e. Protection of Painted Surfaces: Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3. Surface Preparation Standards.

a. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSC-SP2): Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC-SP5) (NACE No. 1): Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by
wheel or nozzle (dry or wet) using sand, grit, or shot.

5. Commercial Blast Cleaning (SSPC-SP6) (NACE No. 3): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7) (NACE No. 4): Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal.

7. Near-White Blast Cleaning (SSPC-SP10-63) (NACE No. 2): Blast cleaning nearly to White Metal Cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.

b. The CONTRACTOR shall note that the definition of Near White Metal Blast Cleaning, SSPC-SP10, is from the 1963 version of the SSPC standard, and requires that 95 percent of "each element" or surface area be free of all visible residues. The other surface preparation standards shall be the most recent versions published by the SSPC.

4. Metal Surface Preparation (Ungalvanized).

a. The minimum abrasive blasting surface preparation shall be as specified in the coating system schedules included at the end of this section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

b. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers (NACE) Standard TM-01-70.

c. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPCX-SP1 prior to blast cleaning.

d. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.

e. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions.

f. The abrasive shall not be reused unless otherwise approved by the OWNER. For automated shop blasting systems, clean oil-free abrasives shall be maintained.

g. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

h. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil/moisture separators which remove at least 95 percent of the contaminants.

i. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to painting.
j. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

k. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.

l. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2, hand tool cleaning or SSPC-SP3, power tool cleaning, will be permitted.

m. Shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

n. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.


a. Plastic and fiberglass surfaces shall be sanded or brush-off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

b. Non-ferrous metal surfaces shall be solvent-cleaned SSPC-SP1 followed by sanding or brush-off blast cleaning SSPC-SP7.

c. All surfaces shall be clean and dry prior to coating application.

6. Workmanship.

a. Skilled craftsmen and experienced supervision shall be used on all WORK.

b. Clean drop cloths shall be used. All damage to surfaces resulting from the work hereunder shall be cleaned, repaired, and refinished to their original condition.

c. All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure that they have been thoroughly cleaned and that they receive an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths of other approved precautionary measures.

7. Shop Coating Requirement.

a. All items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the specified or approved color. The methods, materials, application
equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

b. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

c. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch gear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be shop primed and finish coated and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.

d. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

e. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 6 months before topcoated, or less time if recommended by the coating manufacturer.

f. Damage to shop-applied coatings shall be repaired in accordance with this section and the coating manufacturer's printed instructions.

g. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.


a. The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1, (SSPC-A-1)", Steel Structures Painting Council.

b. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the OWNER in advance.

c. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
d. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this section, whichever has the most stringent requirements.

e. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.

f. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

g. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.

h. Coatings shall not be applied under the following conditions:

1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid weather.

4. When the substrate or air temperature is less than 5 degrees F. above dewpoint.

5. When air temperature is expected to drop below 40 degrees F. or less than 5 degrees F. above the dewpoint within 8 hours after application of coating.

i. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables.

j. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.


a. The CONTRACTOR shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this section, whichever is the highest requirement, prior to placing the completed coating system into service.

b. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examination: The CONTRACTOR shall examine surfaces for conditions that will adversely affect execution, permanence and quality of work.

B. Unsatisfactory Conditions: The CONTRACTOR shall correct unsatisfactory conditions before
proceeding with the WORK.

C. Operational Tests: prior to formal acceptance of WORK, the CONTRACTOR shall successfully start, operate, maintain, stop, and secure all mechanical plants under this project for five 8-hour periods on three consecutive weekdays. Testing sequence shall be completed as described below. The OWNER shall witness the tests. Upon completion of such successful operational tests, submit statement, signed by said witnesses, certifying such successful tests. The CONTRACTOR shall bear all expenses incurred under this provision, witnesses’ expenses excepted.

D. Operating Instruction: Upon completion of WORK and acceptance of operation and maintenance manuals, the CONTRACTOR shall provide bound operational instruction books to the OWNER.

1. Instructions shall include the operation of the plant for a period of 4 hours at a time designated by the OWNER. Upon completion of such instruction, the CONTRACTOR shall obtain from the OWNER a dated and signed statement certifying the completion of such instruction.

E. Review of Work:

1. The CONTRACTOR shall not allow or cause any mechanical work to be covered, concealed or enclosed until such work has been tested and reviewed. Should such work be covered, concealed or enclosed before being tested and reviewed, such shall be uncovered and thereafter restored at no additional cost.

2. The right of the OWNER to conduct job site observation of the CONTRACTOR’s performance is not intended to review the adequacy of the CONTRACTOR’s safety measures in, on, or near the construction site. The CONTRACTOR shall be solely responsible for the adequacy of such safety during all hours of the construction duration.

F. Project Close-Out Requirements:

1. The CONTRACTOR shall provide the following items as prerequisite to the issuance of certificates for final payment and formal acceptance of the project:

   a. Reproducible Record Drawings.
   b. Valve Identification Chart.
   c. ASME Certificates.
   d. Maintenance and Operating Manuals.
   e. Operating Instructions and Certified Statement.
   f. Certified Statement of Successful Test.
   g. Pump Installation Certificate.
   h. Provide all required spare parts.

3.2 INSTALLATION

A. Pipe and Equipment Installation:

1. The CONTRACTOR shall install all piping, valves, and equipment in a manner and in
locations to avoid obstructions and keep openings clear. Pipe and/or equipment shall not be installed where it will present a potential tripping hazard or below 7’-0” above finished floor, where it would be a potential head knocking hazard. Installation shall permit direct access to all valves and pieces of equipment that will require maintenance. The CONTRACTOR shall make any changes as directed by the OWNER, at no additional expense, which may be necessary in order to accomplish this purpose.

2. Before being placed in position, all pipe, pipe fittings and accessories shall be cleaned, and shall be maintained in a clean condition. Piping shall be installed and aligned in accordance with the Drawings with a tolerance of + 1/8-inch in the horizontal and vertical directions.

3. All work specified and not clearly defined by the Drawings shall be installed and arranged as directed and in a manner satisfactory to the OWNER.

B. The CONTRACTOR shall install in accord with Articles and perform the following WORK in accordance with the associated specification section:

1. Excavation, backfilling and dewatering.
2. Equipment installation.
3. Piping installation.
4. Pipe joints.
5. Welding.
6. Cleaning and degreasing of pipe.
7. Testing of piping.
8. Tests and adjustments.
9. Instrumentation and controls.

C. Not Used

D. Installation of Piping:

1. All PVC and ABS Pipe will be transported, stored and installed with regard to manufacturer's recommendations. Bolting of PVC flanges shall be in accordance with manufacturer's recommendations and shall not be unduly stressed through the use of excessive torque while tightening bolts. Use of torque wrench will be required.

2. All life support piping shall be flushed clean prior to connection to equipment or tanks.

E. Installation of Pumps and Motors:

The Contractor shall be responsible for the coordination of the following tests for each pump, drive, and motor:

1. Prior to operation or start up of the pumps, the manufacturer or an authorized representative of the manufacturer shall certify that each pump has been
installed and aligned per the manufacturer’s instructions and installation requirements.

2. Field Tests: All pumping units shall be field tested after installation, in accordance with the Contract Documents, to demonstrate satisfactory operation, without causing excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

   a. Start-up, check, and operate the equipment over the entire speed range. The vibration shall be within the amplitude limits recommended in the Hydraulic Institute Standards and it shall be recorded.

   b. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head. Each power lead to the motor shall be checked for proper current balance.

   d. Electrical and instrumentation testing shall conform to applicable sections of these Specifications.

   e. The field testing shall be witnessed by the Owner or its representative. In the event any of the pumping equipment fails to meet the above test requirements, it shall be modified and retested in accordance with the requirements of these Specifications. The Contractor shall then certify in writing that the equipment has been satisfactorily tested, and that all final adjustments thereto have been made. Certification shall include date of final acceptance test, as well as a listing of all persons present during tests, and resulting test data. The cost of all work performed in this paragraph by factory-trained representatives shall be borne by the Contractor. The Owner will pay for costs of power and water. When such personnel are available, the Owner's operating personnel will provide assistance in the field testing. The Contractor shall not delay the field testing due to the unavailability of the Owner's personnel for assistance.

2. Instruction of Owner's Personnel: The Contractor shall provide for the services of a factory service representative to instruct the Owner's personnel in the operation and maintenance of the equipment. This service shall consist of a one day's visit to the plant for each type of similar pumps larger than 5 HP.

3. After completion of the installation and testing, the Contractor shall remove all debris from the site, clean all the pumping equipment and controls, and hand over this work in perfect operating condition.

4. After completion, the Contractor shall furnish to the Owner the manufacturer's written guarantees that the pumping equipment will operate with the published efficiencies, heads, and flow ranges and meet these specifications. The Contractor shall also furnish the manufacturer's warranties as published in its literature and as specified.
6. Temporary wire screens shall be provided to protect end suction pump inlets during startup. CONTRACTOR shall remove screens no sooner than 14 days and not later than 30 days after start-up and continuous operation of the systems. Screens shall be constructed of heavy gauge stainless steel.

F. System Tests:

1. Prior to hydraulic testing of concrete structures, exhibits, etc., the CONTRACTOR shall determine with a surveying instrument the following elevations:
   a. Bottom of all sumps.
   b. Top of all skimmers, overflows and weirs.
      1. Skimmers shall be level within + 1/4-inch. This information shall be delivered to the OWNER in typewritten form prior to any waterproofing being applied.

2. The CONTRACTOR shall provide one full-time mechanical technician who is familiar with the system for a period of two weeks to aid the OWNER in testing, starting and operating the system.

3. Life Support Piping. Prior to testing, all piping shall be fully supported and anchored and flushed clean with water. All water lines shall be tested using pressurized water at 100 psi. Leakage allowance for all systems shall be zero. All tests shall be carried out under the observation of the OWNER. The CONTRACTOR shall provide notification 7 days in advance of proposed testing. Tests performed without observation will not be valid. Following testing, all piping will be immediately covered or capped to prevent entry of foreign material.
   a. The piping systems shall be subjected to hydrostatic tests by slowly filling the system with water while purging air. It is essential to purge all air from the system. High point air vents shall be added as required to ensure all trapped air can be vented. Slowly bring the pipeline up to the 100 psi and hold for 10 minutes. Slowly release the pressure to zero. The pressurization pumps shall be disconnected from the pipeline and the pressure in the system shall then be monitored for 8 hours while the pipeline is inspected for leaks.
   b. All FRP return piping (on the suction side of pumps) shall be pressure tested as described above as well as vacuum tested. The process shall be performed in a similar manner to the pressure test. A vacuum pump shall be used to draw full vacuum on the pipeline. After full vacuum is achieved, the vacuum pump shall be disconnected from the pipeline. The system must maintain full vacuum for 8 hours.
   c. All buried, encased, or concealed piping shall be tested prior to covering. All buried, encased, or concealed piping shall be tested again after cover or encasement to verify that the piping has not been damaged during the backfill or the intervening period. This test shall be performed as soon as possible and before additional work on the tanks, buildings, or structure further obstructs the piping.
   d. If changes are made to the piping system or additional piping is added after the acceptance of the tests, re-testing is required.
e. If the piping systems do not hold test pressure for the duration of the test, the CONTRACTOR shall locate the exact location of all leaks and replace the defective piping sections. The piping systems shall be re-tested after making repairs.

f. The CONTRACTOR shall isolate all equipment and appurtenances as necessary during the pressure and vacuum tests to ensure that test pressures and test vacuums remain within the rated capacities of such items and do not damage such items.

g. The CONTRACTOR shall provide pipe extensions, temporary pipe caps, temporary pipe supports and any other items that may be required to perform all tests.

END OF SECTION
SECTION 15416 - NATURAL GAS PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide complete installation of gas piping from the 'A' point of delivery up to and including connection to all gas-fired equipment.

B. The work in this section is subject to the requirements of Mechanical General Section 15010.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Materials and Methods - Section 15050
B. Supports and Anchors - Section 15140

1.3 CODES AND STANDARDS:

A. Standard Plumbing Code
B. Standard Gas Code
C. Canadian Standards Association (Formally American Gas Association)
D. NFPA 54

1.4 SUBMITTALS:

A. Submit manufacturer's literature on all piping, valves, fittings, etc. according to Section 15010 - Mechanical General.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS:

A. Schedule 40 black steel pipe ASTM A53, Grade A, B or type F continuous weld, electric weld or seamless with malleable iron class 150 fittings ANSI B16.3 on 2 inches and smaller and carbon steel butt welded fittings ASTM-A-234 on 2-1/2 inches and larger. Make screw joints using Teflon tape. Underground piping shall be coated with X-Tru-Coat or prior approved equal including joints and fittings. Use socket weld fittings on underground ASTM-A-105 with dimensions to ASME B16.11, MSS-SP79, on 2 inches and smaller.

2.2 UNIONS (DIELECTRIC):

A. Class 250 malleable, screwed ASTM-A-197.

2.3 VALVES:

A. Class 125 cast iron, screwed ANSI B16.33 full port for gas service, CSA listed, Homestead Figure 601 for 2 inches and smaller, and Homestead Figure 602 for 2-1/2 inch and larger; Resun or approved equal.

B. Ball Valves may be used for 2 inch and smaller, full port ball valve, 2 piece forged brass body, solid chrome plated ball, blow out proof stem, PTFE seats, UL 125/842 listed for flammable liquids and LP Gas, CSA listed for gas service equal to Hammond 8901, or approved equal. Valve should have following certifications; CGA 9.1 M9.7 Appliance Valves, ISA U.S. No. 3-88 House piping systems, CR91-002 Indoor gas use, CGA-3.16-M88, Appliance & Equipment valves for natural gas & liquefied petroleum, ASME 16.33 Gas piping systems, Valves must have CSA and UL markings on valve body.
2.4 PRESSURE REGULATING VALVES:

A. Cast iron or aluminum body and spring case with stainless steel valve stem, seat ring and valve plug, plated steel springs, neoprene diaphragm and gaskets and TFE disc. Regulating valves shall be sized for the flow indicated and for inlet and outlet pressures indicated. Outlet pressure shall be maintained under the design flow condition and at no flow. Regulating valves over two psi shall be vented full size to outside of the building. Other regulating valves requiring access to the atmosphere shall be equipped with vent piping leading to outside. Provide a pressure relief valve if the regulator connection size exceeds two-inches. Regulating valves shall be Fisher, Maxitrol or prior approved equal meeting ANSI Z21.18.

1. Pressure Gage:
   a. For medium pressure gas; 0-5 psi range. For low pressure gas; 0-30 inch W.C. range. Use low pressure type 2-1/2 inch dial pressure gage with appropriate range, OCI Model CO 34, Trerice, Weksler or approved equal.

2.5 PRESSURE RELIEF VALVES:

A. Cast iron or aluminum body and casing with stainless steel seat ring and valve plug, plated steel springs, neoprene diaphragm, nitrile O-rings and gaskets, and TFE piston ring. Relief valves shall be of sufficient size to relieve wide open flow of the regulator. Install relief valves outside of the building. Relief valves shall be Fisher, Maxitrol or prior approved equal.

PART 3 - EXECUTION

3.1 UNDERGROUND PIPING:

A. Perform work in accord with applicable C.S.A, State and local codes. Install gas stop valve and dielectric union where gas piping enters building.

3.2 CATHODIC PROTECTION:

A. Provide cathodic protection for all underground piping.

3.3 GAS SERVICE:

A. Coordinate installation of gas service line with local gas company. Pay all fees.

3.4 INTERIOR PIPING:

A. Connect to entering line and distribute gas to equipment items requiring gas and as indicated. Perform work in accord with applicable C.S.A., N.F.P.A 54, State and local codes. Install gas stop valves and drip legs at each equipment item. Piping shall be adequately drained with a minimum slope of 1/4 inch per 15 feet and drip legs (full size of pipe) installed at additional points where condensate may collect. Install gas shut off valve and pressure gage inside building at gas entry. Install pressure reducing valves as required to provide pressure within equipment manufacturer’s requirements.

3.5 CONNECTING:

A. Connect equipment items furnished under other sections of specifications.

3.6 TESTS:

A. Test in accord with C.S.A., Standard Gas code, N.F.P.A. 54, and applicable State and local codes.
3.7 ACCESS PANELS:

A. Provide access panels for valves and other items requiring maintenance in enclosed spaces. See Section 15050 for access panel specification. Avoid installing gas appurtenances in enclosed spaces where possible. Install in enclosed spaces only as allowed by applicable codes.
SECTION 15430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This specification describes the requirements for labor and materials required for the installation of plumbing specialties included as part of the building plumbing system.

1.2 SUBMITTALS:

A. Manufacturer’s literature indicating model numbers and options.
   1. Cleanouts
   2. Water Hammer Arresters
   3. Trap Primers
   4. Pressure Reducing Valves
   5. Roof Drains
   6. Floor Drains
   7. Floor Sinks
   8. Air Gap
   9. Trench Drains
   10. Overflow Drains
   11. Downspout Nozzle
   12. Downspout Boots
   13. Backflow Preventer
   14. Wall Hydrants/Hose Bibbs
   15. Thermostatic Mixing Valves
   16. Grease Interceptor

   B. Format shall include a schedule of the specialties submitted and include identification number of each item, such as "FD-1 Floor Drain", a list of each component, accessory, and option of the item being submitted. This schedule must be included in the front of the submittal page.

PART 2 - PRODUCTS

2.1 CLEANOUTS:

A. Cleanouts shall consist of a coated cast iron body with threaded top with spigot or no-hub connection and gasket bronze closure plug with countersunk slot. Head shall be adjustable in height; provide non-skid covers for floor cleanouts. Provide thread shield to protect adjustment threads from concrete as required.

B. Cleanout Covers

<table>
<thead>
<tr>
<th>Location</th>
<th>Adjacent Finish</th>
<th>Material</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior</td>
<td>Terrazzo</td>
<td>Nickel Bronze</td>
<td>Round Recessed Top</td>
</tr>
<tr>
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<td>Tile</td>
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</tr>
<tr>
<td>Interior</td>
<td>VCT</td>
<td>Nickel Bronze</td>
<td>Square Recessed Top</td>
</tr>
<tr>
<td>Interior</td>
<td>Carpet</td>
<td>Nickel Bronze</td>
<td>Round, Carpet Marker</td>
</tr>
<tr>
<td>Interior</td>
<td>Concrete</td>
<td>Nickel Bronze</td>
<td>Round</td>
</tr>
<tr>
<td>Exterior</td>
<td>Concrete</td>
<td>Cast Iron</td>
<td>Vandal Proof Secured Top</td>
</tr>
<tr>
<td>Wall</td>
<td>All</td>
<td>Chrome Plated</td>
<td>Covers</td>
</tr>
</tbody>
</table>

C. Cleanouts shall be Jay R. Smith, Wade, Josam, Zurn or MIFAB.
2.2 WATER HAMMER ARRESTERS:

A. Water Hammer Arresters shall be constructed of a stainless steel or copper shell, stainless steel or elastomer bellows, with pre-charge of air, nitrogen, or argon. Arresters shall conform to ASSE Std. 1010, and shall be Zurn "Shoktrol", Josam "Absorbatron", Wade "Shokstop", or Precision Plumbing Products "Shock Arrestor". Sizing shall be according to PDI Standards.

2.3 PRESSURE REDUCING VALVES (DOMESTIC WATER)

A. Pressure Reducing Valves 2 inch and smaller shall be equal to Watts Series U5B-GG bronze body single seated with composition diaphragm and stainless steel spring, direct acting with strainer on inlet side, integral by-pass check valve, gauge, and threaded ends.

B. Pressure Reducing Valves 2 ½ inch and larger shall be equal to Watts No. 115-3-E-Y, cast iron body, bronze trim with composition disc, hydraulic check, and flanged ends, and strainer. See drawings for pressure variation.

2.4 TRAP PRIMERS (TP):

A. Trap Primer to prime multiple traps. Automatic brass trap primers activated by a drop in building water pressure, with trap primer distribution unit. P-1 or P-2 Primer with DU-2, 3, or 4 Distribution Unit by Precision Plumbing Products, Inc. or approved equal, Zurn, Smith, MIFAB, and Josam are acceptable manufacturers. ASSE Standard 1018.

B. Trap Primer to prime single trap. Automatic brass trap primer activated by a drop in building water pressure. P-2 Primer as manufactured by Precision Plumbing Products, Inc. or approved equal Manufacturers. ASSE Standard 1018.

2.5 ROOF DRAINS (RD):

A. Roof drains shall consist of coated cast iron body with non-puncturing flushing clamp with integral gravel stop and deck clamp. Drain shall have an adjustable extension to place flashing clamp above insulation while body rests on the roof structure. Provide aluminum roof dome. Provide 1710 expansion joint if piping is not offset below the roof, Jay R. Smith 1015Y-R-C-AD, Wade, Josam, Zurn, or MIFAB are approved equal.

2.6 OVERFLOW DRAINS (OD):

A. Overflow roof drains shall consist of coated cast iron body with non-puncturing flashing clamp, two (2) inch water dam, and deck clamp. Provide aluminum roof dome. Provide 1710 expansion joint if piping is not offset below roof. J.R. Smith 1080Y-R-C-AD Wade, Josam, Zurn and MIFAB are approved equal.

2.7 FLOOR DRAINS (FD):

A. FD-1: Floor and shower drain, coated cast iron body with bottom outlet, ½" trap primer connection, combination invertible membrane clamp and adjustable collar with type "B" round polished nickel-bronze light duty strainer top with square heel proof openings and secured grate. Zurn ZN-415-P-NH or approved equal by Smith, Wade, Josam or MIFAB.

B. FD-2: Medium duty drain with Sur-Set bucket, 9" diameter medium duty cast iron grate, coated cast iron body; ½" trap primer connection, bottom outlet, seepage pan, and combination membrane clamp. Zurn Z-554-P-NH or approved equal by Wade, Josam, Zurn, or MIFAB.
2.8 FLOOR SINKS (FS):
   A. FS-1: Sanitary coated cast iron floor drain with nickel bronze rim and grate, aluminum dome 
      bottom strainer and deep seal trap, trap primer connection. Jay R. Smith 3100-12-P with ½ 
      grate or approved equal by Wade, Josam, Zurn or MIFAB.
   B. FS-2: Sanitary coated cast iron floor drain with nickel bronze rim and grate, aluminum dome 
      bottom strainer and deep seal trap, trap primer connection. Jay R. Smith 3160-11-P deep 
      receptor with no grate (for dishwasher use) or approved equal by Wade, Josam, Zurn or MIFAB.

2.9 CAN WASH DRAIN (CWD):
   A. 12" x 12" x 8" deep cast iron body with bottom outlet, anchor pan, medium duty cast iron loose 
      slotted grate, standing sediment bucket with white acid-resisting coated interior and top. 
      Complete with chrome-plated bronze spray nozzle and water supply assembly. Equal to Zurn 
      Z-1982-NH. Wade, Smith, Josam, MIFAB are approved equals.
   B. Water supply control box assembly, 18-8 type 304 stainless steel with cylinder lock and hinged 
      cover, bronze control valves, screwdriver stops, and atmospheric type vacuum breaker. Equal 
      to Zurn Z1464. Wade, Smith, Josam, MIFAB are approved equals.

2.10 DOWNSPOUT NOZZLE:
   A. Wall mounted outlet nozzle for storm drainage, plain bronze body, decoration face of wall and 
      flange, with screen and threaded connector. Units shall be Zurn ZARB-199-FS, or equal by 
      Josam, Smith, Wade and MIFAB.

2.11 DOWNSPOUT BOOTS:
   A. Transition fitting between sheet metal downspout and underground piping. Boots shall be cast 
      iron rectangular or round inlet to 4 in. spigot. Units shall be Jay R. Smith 1785, 1786, or 1787, 
      as required for connection to downspout.
   B. Wade, Josam, Zurn and MIFAB are approved equal.

2.12 BACKFLOW PREVENTERS:
   A. Double check valve assembly (meeting ASSE 1015)
      1. 2 ½ inch and larger. Epoxy coated cast iron body, replaceable bronze seats, with OS 
         and Y Gate Valves. Watts Series 709.
      2. 2 inch and smaller. Include top mounted test cocks, replaceable seats and discs, with 
         inlet strainer, and quarter turn, full port, resilient seat ball valves. Watts Series 007-QT-S.
      3. Wilkins, Conbraco, Febco are approved equals.
   B. Reduced Pressure Zone Assembly (Meeting ASSE 1015)
      1. 2 ½ inch and larger. Epoxy coated cast iron check valve bodies with bronze check seats 
         and stainless steel relief valve seats, OS and Y Gate Valves with UL/FM resilient seats, 
         and air gap fitting. Watts Series 909 OSY.
      2. 2 inch and smaller. NPT body connections, quarter turn, full port, resilient seated bronze 
         ball valve, and strainer. Watts Series 909 QT.
      3. Wilkins, Febco, and Conbraco are approved equal.
2.13 WALL HYDRANTS/HOSE BIBBS:

A. General: Wall hydrants shall be bronze, with integral vacuum breaker, ¾ inch hose thread, and key operator. Units shall be non-freeze type approved equals by Jay R. Smith, Wade, Josam, Zurn or MIFAB are acceptable.

B. Lockable Wall Hydrant (WH-1): Nickel bronze plated, quarter turn stainless steel box with hinged locking cover. Jay R. Smith 5509 QT.

C. Hot and Cold Wall Hydrant (WH-2): Combination hot and cold water, non-freeze, encased wall hydrant for flush installation. 3/4 inch female inlet adapter, cylinder lock, nickel bronze box and hinged cover, 3/4 inch vacuum breaker, for wall thickness required; Zurn Z1325-3-5-12.

D. Hose Bibb (HB-1): Chrome plated, ¾ inch hose thread outlet, lock shield cap with integral vacuum breaker. Chicago Faucet No. 952 or T&S Brass.

2.14 THERMOSTATIC MIXING VALVES ASSEMBLY

A. Large and small thermostatic mixing valves.

B. Solid bi-metal thermostats, color coded dials, adjustable limit stops set for 1200 F, integral check stops.

C. Color coded dial: Cold - Hot (C - H).

D. Inlets with integral check stops.

E. Pressure regulating valve with pressure gauges.

F. Thermometers on inlets, outlet, and return piping.

G. Full port ball valves on inlets, outlet, and test connection.

H. Circulator, aquastat, and switch box.

I. Return piping circuit setter, drain valve.

J. Check valves on return and ½” bypass lines.

K. Unit mounted on galvanized strut with cushioned clamps.

L. Rough bronze finish.

M. Factory, preassembled, and pre-tested.

N. Vacuum breakers on all hose connections.

O. Holby, Symons, Leonard, and Watts are also approved manufacturers.

2.15 GREASE INTERCEPTOR:

A. Recessed: IN GRADE.

B. Separator shall be precast concrete.

C. Above Floor:

D. Separator shall be welded steel, epoxy coated interior and exterior, PDI rated, with internal air relief bypass, bronze cleanout plug and visible double wall trap seal with removable
combination pressure equalizing/flow diffusing baffle and sediment tray. Gasket non-skid secured cover with enzyme port opening having bronze plug, complete with flow control fitting.

E. Unit shall be Zurn Z-1170 Series.

F. Smith, Josam, Wade, and MIFAB are also acceptable manufacturers.

PART 3 - EXECUTION

3.1 CLEANOUTS:

A. Cleanouts shall be installed in horizontal runs at spacing of no more than 75 feet. Install cleanouts at the base of every soil and waste stack, and at each 90 degree change in direction. Install cleanouts which are not easily accessible up through floor or wall and provide applicable covers. Install cleanouts to allow at least 18" for Roding.

3.2 WATER HAMMER ARRESTERS:

A. Water hammer arrestors shall be sized to actual pipe size and installed as near the shock source as practical. Install to allow unobstructed path from shock source to arrestor.

3.3 TRAP PRIMERS:

A. Trap primers shall be provided for all floor drains and floor sinks. Install trap primer valves and accessories per manufacturer's instructions. Trap primers shall be installed level and in accessible locations. Provide Distribution Units as required.

3.4 PRESSURE REDUCING VALVES:

A. Install Pressure Reducing Valves where shown on drawings. Set final outlet pressure for 60 psi unless otherwise indicated. Install in horizontal and accessible location. Install shut off valves and strainer (unless integral with unit) upstream of pressure reducing valve and shut off valve downstream of the pressure reducing valve. Install pressure gage, unless integral with unit, downstream of pressure reducing valve.

3.5 ROOF DRAINS (RD):

A. Roof drains shall be installed as recommended by the manufacturer. Coordinate the work with roof deck and roofing contractors to insure proper and timely installation.

3.6 FLOOR DRAINS AND FLOOR SINKS:

A. Flush-floor drains shall be able to support traffic. Drains installed in building floor shall be sealed in such a manner as to prevent leakage of water around trap and body to ceiling below.

B. Provide 3 foot. square, 6 mil butyl membrane, at each floor drain. Clamp membrane. Membrane shall be placed below tile grout. Membrane shall be recessed in the floor slab with topping poured over it.

3.7 CAN WASH DRAIN ASSEMBLY:

A. Install in a manner similar to floor drain installation.
3.8 TRENCH DRAINS:

A. Trench drains shall be installed as recommended by the manufacturer. Coordinate the work with waterproofing contractor and general contractor to insure proper and timely installation.

3.9 OVERFLOW DRAINS (OD):

A. Overflow drains shall be installed as recommended by the manufacturers. Coordinate the work with roof deck and roof contractors to insure proper and timely installation.

3.10 DOWNSPOUT NOZZLES:

A. Shall be installed on overflow drains discharging above grade. Provide fine mesh bronze or stainless steel screen to prevent animals or insects from nesting.

3.11 DOWNSPOUT BOOTS:

A. Shall be installed on downspouts discharging into underground storm sewer.

3.12 BACKFLOW PREVENTERS:

A. Backflow preventers shall be installed by qualified personnel per manufacturer's instructions. After installation, but before system is put into service, test backflow preventer for functionality with test kit as recommended by manufacturer. Pipe discharge from backflow preventer vent to nearest floor drain with connection-size copper tubing. Ensure air gap is provided in relief line either by air gap fitting or elevated discharge above drain. Backflow preventers shall have unions for removal. Backflow preventers shall be provided on domestic water lines as indicated on the drawings.

3.13 WALL HYDRANTS/HOSE BIBBS:

A. Install hose bibs and wall hydrants as indicated on drawings, minimum height 18” A.F.F. unless otherwise indicated.

3.14 THERMOSTATIC MIXING VALVES:

A. Install thermostatic mixing valve as indicated on the drawings. Provide pre-assembled unit. Provide factory representative set up.

3.15 GREASE INTERCEPTOR:

A. Install interceptors according to manufacturer's recommendations.

END OF SECTION
SECTION 15440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
A. This specification describes the requirements for plumbing fixtures, related components and their installation.

1.2 SUBMITTALS:
A. Submittals shall include manufacturer's data sheets and dimensional information on all fixtures and accessories according to Section 15010 - Mechanical General.
B. Format shall include a schedule of the fixtures submitted including identification number of each item, such as "WC-1 Water Closet", and list of each component and accessory of the fixture, including manufacturer's model number. This schedule must be included in the front of the submittal booklet.

1.3 CODES AND STANDARDS:
D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   3. Vitreous-China Fixtures: ASME A112.19.2M.
F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Faucets: ASME A112.18.1M.
   5. Supply and Drain Fittings: ASME A112.18.1M.
G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   2. Brass and Copper Supplies: ASME A112.18.1M.
   4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
H. Comply with the following applicable standards and other requirements specified for
miscellaneous components:
2. Off-Floor Fixture Supports: ASME A112.6.1M.

I. NSF Standard: Comply with NSF 61, "Drinking Water System Components—Health Effects," for fixture materials that will be in contact with potable water.


PART 2 – PRODUCTS:

REFER TO BASIS OF DESIGN SCHEDULE FOR FIXTURE TYPES AND MODEL NUMBERS

2.1 GENERAL:

A. Vitreous ware shall be white, regular section, of weight required, free from cracks, flaws, blisters, crazes or other defects. Provide with mounting brackets for wall mounted fixtures unless floor carriers are indicated.

B. Stainless steel shall have machine ground finish. Decks and sink compartment sides shall be buffed. Exposed surfaces shall have no. 4 satin finish. Interior surfaces shall be deadened. Exposed metal parts shall be chromium plated and protected during construction by a coat of grease.

C. Closet and urinal carriers shall have tapered thread face plate, plastic coupling with test cap, and neoprene rubber gasket. Lavatory, sink and urinal carriers shall have rectangular structural steel uprights. Carriers shall have necessary accessories for proper installation.

D. Water closets and urinals shall have bolt caps.

E. Seats shall be white, solid plastic, with internal check and molded stainless steel hinge without visible metal parts, except as hereinafter specified.

F. Chromium plated traps shall be brass with chromium plated nipple to wall and escutcheon.

G. Fittings and accessories specified designate type only; provide modifications to make fittings work properly with fixture and piping.

H. Provide necessary tailpiece and shanks.

2.2 FIXTURES

A. Provide fixtures, in complete working order, as described on the drawing.

2.3 ACCEPTABLE MANUFACTURERS:

A. Fixtures, Vitreous China - American Standard, Crane, Eljer, Kohler, Toto

B. Fixtures, Stainless Steel - Just, Elkay, Advance Tabco, Amtekco Industries

C. Flush Valves - Sloan, Delaney, Zurn, Toto

D. Toilet Seats - Olsonite, Sperzel, Church, Beneke, Bemis, Toto

E. Faucets - T&S Brass, Speakman, Chicago, Symons, Eljer, Delta, Toto
F. Terrazzo - Fiat, Cutler, Florestone, Stern-Williams
G. Trim, Chromed Brass - McGuire, Sanitary Dash, Bridgeport
H. Shower Mixing Valves - Powers, Leonard, Lawler, Symons, Speakman, Zurn
I. Shower Heads - Symons, Speakman, Zurn
J. Electric Water Coolers - Elkay, Halsey Taylor, Sunroc, Oasis, Haws. Use only water coolers which do not use CFC’s for refrigeration.
K. Scrub Sinks - Eljer, American Standard, Kohler, Crane, Elkay, Just
L. Carriers - J. R. Smith, Josam, Zurn, Wade, Mifab
M. Emergency Equipment - Guardian, Haws, Western, Speakman
N. Wash Fountains - Acorn Engineering, Bradley Corp., Intersan Manufacture

2.4 KITCHEN EQUIPMENT, CONNECTIONS, AND ACCESSORIES

A. Install plumbing rough-in and provide connections to Kitchen Equipment as shown on the Plumbing Drawings and on Kitchen Equipment Supplier Drawings. Provide piping valves, and fittings not provided by the Kitchen Equipment Supplier, included, but not limited to the following:

1. For Sinks - P-traps, supplies, continuous waste assemblies, stops, and other trim required for a complete functioning feature. Provide indirect waste piping, where required, to floor sinks. Waste piping to floor sinks serving sinks with hot water will be type M copper with DWV copper fittings. Stops, supplies, and traps shall be equal to those manufactured by McGuire Brass Company.
2. Other Kitchen Equipment - Provide traps, wastes piping assemblies, stops, and supplies as manufactured by McGuire Brass Company to make a complete functioning fixture. Use Kitchen Supplier Drawings in conjunction with Plumbing Drawings and schedules.

PART 3 - EXECUTION

3.1 GENERAL:

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures are installed in accordance with pertinent codes and regulations and reference standards.
B. Verify location of rough-in for potable water and waste piping.
C. Examine walls, floors, and millwork for conditions suitable for fixture installation.
D. Carriers shall have short feet. Lavatory carriers shall have concealed arms. Bolt carrier feet to the floor with 2 inch bolts and anchors.
E. Flush valves shall be ASSE 1001 diaphragm type, quiet, screwdriver stop with cover, vacuum breaker, solder sweat kit, and handle.

3.2 INSTALLATION:

A. Install plumbing fixture level and plumb, in accordance with fixture manufacturer’s published literature, rough-in drawings, codes regulations, and reference standards.
B. Fasten plumbing fixtures securely to supports or building structure. Rigidly support water supplies behind or within wall constriction.
C. Provide stop valve in the water supply to each fixture in an accessible location.
D. Connect wall hung urinals to waste piping with red brass nipples.
E. Connect fixtures to water supply with copper or brass (no steel).
F. Each fixture and piece of equipment requiring connection to drainage system to have separate traps installed as close to fixture as possible, except fixtures with integral traps.
G. Provide iron or steel backing for all wall mounted fixtures (or wood backing only if building structure is wood).
H. Provide escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
I. Apply SCP3154 primer and General Electric Co.’s No. 1702 silicone sanitary sealant around plumbing fixtures to conceal voids at wall and contact points of fixture after walls have been painted. Match sealant color to fixture color.
J. Apply SCP3154 primer and General Electric Co.’s Silpruf Sealant on plain concrete walls.
K. Floor mounted water closets to be 12 inch rough-in (except special fixtures).

3.3 TESTING AND QUALITY CONTROL:
A. Inspect each unit for damage. Replace damaged fixtures.
B. Test fixtures to demonstrate operation. Replace malfunctioning units and retest.
C. Adjust water pressure at faucets, shower valves, and flush valves to provide proper flow, and temperature.
D. Replace washers of leaking or dripping faucets and stops. Clean fixtures, trim, and strainers using manufacturer’s recommended cleaning methods and materials.
E. Adjust fixture flow regulators for proper flow and stream height.
F. Adjust water-cooler temperature settings.

3.4 CLEANING:
A. Clean fixtures, trim, and strainers using manufacturer’s recommended cleaning methods and materials. Remove labels.
B. Remove faucet spouts and strains, remove sediment and debris, and reinstall spouts and strainers.

3.5 PROTECTION:
A. Provide protection covering for installed fixtures, water coolers, and trim.
3.6 MOUNTING HEIGHTS SCHEDULE:

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Mounting Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory or Sink</td>
<td>31 inches floor to rim (34 inches for ADA Compliant)</td>
</tr>
<tr>
<td>Water Closet</td>
<td>15 inches floor to rim (17 inches for ADA Compliant)</td>
</tr>
<tr>
<td>Urinal (Wall Hung)</td>
<td>24 inches floor to lip (17 inches for ADA Compliant)</td>
</tr>
<tr>
<td>Drinking Fountain</td>
<td>42 inches floor to bubbler (36 inches for ADA Compliant)</td>
</tr>
</tbody>
</table>

Showers:
- Average Height: 72” Adult Male or Unisex
- Bottom of Shower: 65” Adult Female
- Head to Floor
- Shower Valve to Floor: 32”

END OF SECTION
SECTION 15450 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This specification describes the requirements for labor and materials necessary for the installation of plumbing equipment included as part of the building plumbing system.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 SUBMITTALS:

A. Submittals shall include:
   1. Water Heaters
      a. Manufacturers Data Sheets
      b. Certified Dimensional Drawings

   2. Booster Pumps/Circulating Pumps/Sump Pumps
      a. Manufacturers Data Sheets
      b. Certified Dimensional Drawings
      c. Central Panel Wiring Diagram

B. Format shall include a schedule of the items of equipment submitted and include identification number of each item, such as "WH-1 Water Heater", and list of each component, accessories, and options. Include the schedule in the front of the submittal package.

PART 2 - PRODUCTS

2.1 INSTANTANEOUS (Tank less) WATER HEATER: (GAS)

A. Equal to Rheem Gas instantaneous water heater; flow regulator, ABS UL 94 Vo rated cover, replaceable cartridge element made of nickel-chrome; 3/8" compression nuts and sleeves, maximum operating pressure of 150 psi. Rennai and Bradford-White are approved equals.

2.2 CIRCULATING PUMP:

A. Domestic hot water circulating pump shall be Taco, Armstrong, Bell and Gossett, or prior approved equal in line centrifugal pump with iron and bronze construction, provided with flanged connections, bronze impellers, and mechanical seals. Motors shall be rigid coupled, supported from pump casing. Motor shall have internal overload protection. Water or oil lubricated motors are acceptable. Pump motor shall not exceed 1800 rpm.

PART 3 - EXECUTION

A. See details on drawings for installation of water heaters and circulating pumps, etc.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
A. The work required under this section includes all work necessary for a complete installation of refrigerant piping and accessories.
B. The work of this section is subject to the requirements of the Mechanical General Provisions.

1.2 CODES AND STANDARDS:
B. ANSI B31.5 Refrigeration Piping Code
C. US EPA Clean Air Act 1990-CFR 40 Part 608

1.3 SUBMITTALS:
A. Submit manufacturer's literature on all products and accessories.

PART 2 - PRODUCTS

2.1 PIPING:
A. Refrigerant piping shall be type L, hard drawn copper tubing conforming to ASTM Specification B-280, cleaned and capped and marked “ACR”.
B. Fittings for refrigerant lines shall be as wrought copper or forged brass conforming to ANSI/ASME standard B16.22.
C. Joints in refrigerant lines shall be brazed or flanged.
   1. Brazed joints shall be made up in accordance with ANSI B9.1.
   2. Flanged joints (used on systems over 100 tons) shall be solder type, four bolt, forged brass, tongue and groove type.

2.2 VALVES, AND ACCESSORIES:
A. Filter Drier:
   1. Filter-drier shall be a Henry Valve Co., V-8000 series, filter-drier; Sporlan and Alco are approved equals.
B. Service Valves:
   1. Valves shall be back seating type, steel or iron body. Valves shall be Henry Valve Co., Compressor Valves. Sporlan and Alco are approved equals.
C. Isolation Valves:
   1. Isolation valves shall be Henry Valve Co., 900 series ball valves. Sporlan and Alco are approved equals.
D. Charging Valve:
   1. Charging valve shall be a Henry Valve Co. type 927 or approved equal. Sporlan
and Alco are approved equals.

E. Sight Glass:

1. Sight glass shall be Henry Valve Co. MI 31 series double port style with extended ends for soldering for lines 5/8 inch OD or larger. Use MI 30 series single port soldering for lines 5/8 inch OD or larger. Use MI 30 series single port for lines 1/2 inch OD and smaller. Sporlan and Alco are approved equals.

F. Liquid Line Solenoid Valve:

1. Valves shall be Sporlan "E" Series or Alco with molded coil, and extended solder connections. Valves shall be normally closed with manual lifting stem.

G. Thermostatic Expansion Valve (TXV):

1. TXV shall be balanced externally equalized type.
2. Distributions shall be matched with thermostatic expansion valves and direct expansion coil for proper performance. Distributors shall be Alco or approved equal.

H. Refrigerant Distributors:

1. Distributors shall be Alco or approved equal.

I. Hot Gas Bypass Valve:

1. Provide hot gas bypass valves where indicated. Valves shall be Sporlan ADR series, adjustable.

J. Suction Line Accumulators:

1. Unit vessel shall be U.L. listed when shell diameter is less than 6 inches and ASME stamped for larger shell diameters. Accumulators shall be AC&R S-7000 series. Accumulator shall have liquid level switch to shutoff compressor on high liquid level.

K. Relief Valves:

1. Relief valves shall be brass body, suitable for refrigerants R-12 or R-22, factory sealed. Valves shall be constructed in accordance with ASME requirements and shall bear the ASME "UV" symbol and National Board Certification. Valves shall be sized in accordance with ANSI B9.1-latest issue. Valves shall be Henry 522 or 524 series. Superior is an approved equal.

L. Flexible Connectors:

1. Flexible connectors shall be braided bronze covering on a bronze hose. End connectors shall be female copper tube type. Units shall be rated not less than 270 psi at 250 degrees F. Units shall be Southeastern Hose, Inc., Superior or Anaconda.

PART 3 - EXECUTION

3.1 GENERAL:

A. Furnish and install the refrigeration equipment, piping and accessories, listed herein or shown on the drawings. Perform pressure and leakage tests. Evacuate the system;
provide refrigerant charge and oil to properly operate the system. Adjust control devices for proper operation.


C. The refrigerant tube sizes and installation of tubing shall be in accordance with the equipment manufacturer's recommendations.

D. Refrigerant suction line size shall limit the temperature rise to two degrees F at full load and hold the refrigerant gas velocity to not less than 500 ft. per min. (fpm) in the horizontal nor less than 1000 fpm in the vertical at minimum load.

E. Refrigerant liquid line size shall limit the pressure drop between 4 and 6 psi at full load.

F. Refrigerant hot gas bypass line shall be sized similarly to suction lines, limiting the pressure drop between 4 and 6 psi with a maximum velocity of 4000 fpm.

3.2 INSTALLATION:

A. Provide a line size filter-drier in each liquid refrigerant line between the condenser and the expansion valve.

B. Provide service valves at condensing unit. Service valves shall be lines size.

C. Provide isolation valves around the filter-drier to permit servicing the drier without loss of refrigerant.

D. Charging valve shall be installed in each liquid refrigerant line between the condenser and the filter drier.

E. Sight glass, moisture indicator shall be installed in each liquid refrigerant line at the evaporator coil.

F. Provide liquid solenoid valves in each liquid line. Valves shall be normally closed with manual lifting stem.

G. Provide balanced externally equalized thermostatic expansion valve. Distributors shall be matched with thermostatic expansion valves and direct expansion coil for proper performance.

H. Provide refrigerant distribution for each thermostatic expansion valve. Distributors shall be matched with thermostatic expansion valves and direct expansion coil for proper performance.

I. Provide hot gas bypass valves where indicated.

J. Provide relief valve.

K. Pitch hot gas lines and suction lines approximately 1/8 inch per 10 ft.

L. Locate bulb for TXV on horizontal section of evaporator outlet. Strap bulb to side of tubing with two straps.

M. Locate bulb in accordance with manufacturer's recommendations. Connect the equalizing line to the TXV down stream of the bulb. Provide trapped double suction risers on systems with unloading capability, when required for proper oil return.
N. Hot gas lines and suction lines exceeding 30 ft. vertical lift shall be trapped every 20 ft.

O. Provide isolation valves on hot gas bypass line.

P. Relief valves shall be installed where indicated, in a brass bushing threaded into a forged brass tee.

Q. Provide flexible connectors on liquid line, hot gas bypass and suction line at the condensing unit and air handler.

3.3 WORKMANSHIP:

A. Keep refrigeration piping sealed until it is used. Can open ends of installed piping until ready for final connections.

B. Vertical refrigerant lines shall be run plumb; horizontal lines shall run parallel with building walls.

C. Refrigerant lines shall not contact building structure. Isolate piping with resilient liner in pipe support or elastomeric insulation.

3.4 TESTING, DEHYDRATION, EVACUATION AND CHARGING:

A. Upon completion of the piping systems, prior to insulation the piping system shall be tested at 350 psig for 2 hours.

B. Charge refrigerant into the system to a pressure of 10 psig. Leaving the refrigerant in the system, pressurize the system with oil pumped dry nitrogen to 350 psig. Test for leaks with an electronic leak detector. Repair leaks, refill, re-pressurize, and retest. Discharge system pressure.

C. Connect two vacuum pumps to system. One pump should be connected to the suction side of the system, the other to the liquid side. Pump both sides down to a vacuum of 10 inches Hg., holding this vacuum for a period of 5 minutes.

D. Connect a cylinder of oil pumped dry nitrogen and fill the system to atmospheric pressure. Reconnect vacuum pumps and evacuate again to 10 inches Hg. Close charging valves and monitor vacuum for 12 hours. If the vacuum remains unchanged for 12 hours the system may be charged.

E. Follow standard charging procedures. Charge through the system filter-drier.

F. Check oil level after six hours of operation.

G. Change filter driers after 40 hours of operation.

END OF SECTION
SECTION 15671 - CONDENSING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections.

1.2 SUMMARY
A. This Section includes design, refrigerants, controls, and installation requirements for air-cooled scroll compressor condensing units.

1.3 REFERENCES:
A. Comply with the applicable Standards and/or Codes of ETL, CETL, NEC, ASHRAE Standard 90.1, and OSHA as adopted by the State.

1.4 SUBMITTALS:
A. Product Data: Include manufacturer’s technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting to supporting structure.
1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
D. Maintenance Data: Maintenance manuals specified in Division 1.
E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE
A. Fabricate and label system to comply with ASHRAE 15, “Safety Code for Mechanical Refrigeration.”
B. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
C. Qualifications; Equipment manufacturer must specialize in the manufacture of the products specified and have five years experience with the equipment and refrigerant offered.

1.6 DELIVERY AND HANDLING
A. Condensing unit shall be delivered to the jobsite with factory holding charge and be factory charged with oil by the manufacturer.
B. Comply with the manufacturer’s instruction for rigging and handling equipment.
PART 2 - PRODUCTS:

2.1 MANUFACTURERS:

A. The basis of design is Aaon. Desert Aire and Addison are approved equals.

2.2 CONDENSING UNITS:

A. Unit Description: Provide and install as shown on the plans, factory assembled, sir-cooled scroll compressor condensing units in the quantity specified. Each unit shall consist of an air-cooled condenser section and isolated control compartment containing: hermetic compressor(s) control system, suction and liquid connection valves, and all components necessary for safe and controlled unit operation when connected to the specified low side equipment.

B. Construction:

1. Unit shall be completely factory assembled, piped, and wired and shipped in one section.
2. Unit shall be specifically designed for outdoor application.

C. General: Provide a complete scroll compressor condensing unit as specified herein and as shown on the drawings.

D. Paint finish shall be capable of withstandng at least 1,000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

E. Compressors: The compressors shall be a tandem, sealed hermetic scroll type with a forced feed lubrication systems and oil charge. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all phases and shall be mounted on rubber-in-shear vibration isolators. Each compressor shall be furnished with a crankcase heater:

1. Options: The compressor shall be covered by a high-density foam sound attenuating blanked to reduce radiated noise.

F. Condenser: The condenser coil(s) shall consist of seamless copper tubes mechanically bonded into plate type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling section shall be an integral part of the main condenser coil. Condenser fan(s) shall be propeller type arranged for (horizontal air discharge), (vertical air discharge), and individually driven by direct drive fan motor(s). The fan discharge area shall be equipped with a heavy-gauge fan guard. Fan motor(s) shall be weather protected, single-phase, direct-drive, 1,100 rpm, open drip-proof type. The condenser coil(s) shall be mechanically protected from physical damage by (a wire guard) (galvanized steel louvers) covering the full area of the coil.

G. Rear doors providing access to condenser fan(s) and coil(s) for maintenance and service shall be factory installed.

H. Condenser coils shall be copper tubes with copper fins mechanically bonded to the tubes (and 304 stainless steel end castings).

I. Refrigerant Circuit: The condensing unit shall operate with R-410A refrigerant. The condensing unit shall be furnished with a liquid line filter drier and service valves for liquid and suction connections. The finished field installed refrigerant circuit furnished by the contractor shall include the low side cooling components, refrigerant, thermal expansion
valve, liquid line (insulated hot gas bypass line) (insulated hot gas line), and insulated suction line.

1. Hot gas bypass shall be provided on the first refrigerant circuit.
2. First stage cooling shall be provided with condenser fan cycling to allow operation down to 35° F.
3. Unit shall dehumidify using a hot gas rehear coil, modulating hot gas reheat control valves piped to the lead refrigeration system, and an electronic controller. A factory-wired, field installed, supply air temperature sensor and a field-installed space humidity sensor shall be provided to control the amount of reheat. The supply air temperature setpoint shall be adjusted on the electronic controller within the controls compartment.

J. Control System: A centrally located weatherproof control panel shall be isolated from airstream, and shall contain the field power connection points, control terminal block, and control system. Power and starting components shall include fan motor contactors, time delay relay(s) for the compressor(s), inherent fan motor overload protection and unit power terminal blocks for connection to remote disconnect switch. Safety and operating controls shall include a manually reset high pressure switch and an automatic reset low pressure switch. Barrier panels shall be furnished to protect against accidental contact with line voltage when accessing the control system.

K. Service accessibility: Entrance to the compressor(s) and control compartment shall be through an access panel.

L. Wiring Diagrams:
1. Wiring Diagrams shall be in color and marked to match the color and markings of the wires and shall be both “point-to-point” and “ladder” diagrams.
2. Diagrams shall be laminated in plastic and permanently fixed to the control compartment door.
3. Installation and maintenance manuals shall be supplied with each unit within the control compartment.

M. Power Options:
1. Unit shall be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage, or the voltage is more than 10 % under design voltage or on phase reversal.
2. Unit shall be provided with a factory installed and wired 115 volt, 12 amp ground fault service receptacle powered by a 1.5 kVA transformer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in strict accordance with manufacturer’s requirements, shop drawings, and contract documents.
B. Adjust and level unit on supports.
C. Install refrigerant piping in accordance with drawings.
D. Evacuate the system and charge with refrigerant in accordance with standard practice.
E. Coordinate electrical installation with electrical contractor.
F. Coordinate controls with controls contractor.
G. Provide all appurtenances required to insure a fully operational and functioning system.

3.2 STARTUP

A. Check and assure proper system charge of refrigerant and oil.

B. Provided testing, and starting of system, and instruct the Owner in its proper operation and maintenance.

END OF SECTION 15671
SECTION 15775 - ELECTRIC HEAT TRACING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This specification describes the installation and termination of heat tracing cable for piping.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 SUBMITTALS:

A. Submittals shall include the following information and data:

1. Manufacturer's data sheets on all catalog items to be used.
2. Manufacturer's installation instructions and details.

1.3 STANDARDS:

A. National Fire Protection Association

1. NFPA 70 National Electrical Code

PART 2 - PRODUCTS

2.1 CABLE:

A. Heat tracing cable, U.L. listed self regulating type with conductive polymeric core, copper bus wires and, chemical resistant outer jacket. Raychem XL Trace series or prior approved equal.

B. Cable shall be available in the following wattages:

1. 5 watt/ft @ 50 degrees F

C. Cables shall have T-6 rating at 185 degrees F in accordance with NEC.

D. Cable shall be labeled at spacing not exceeding 2 ft. with the following:

1. Manufacturer's name, product identification, number coding to identify manufacturing batch.

2.2 ACCESSORIES:

A. Thermostat shall be United Electric with the following features and ratings:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>NEMA 4X, epoxy coated cast aluminum, exposed hardware stainless steel</td>
</tr>
<tr>
<td>Range</td>
<td>15 to 140 degrees F</td>
</tr>
<tr>
<td>Switch</td>
<td>SPDT - U.L. listed microswitch</td>
</tr>
<tr>
<td>Electrical Rating</td>
<td>22 amps, 125/250/480 VAC</td>
</tr>
</tbody>
</table>
Differential 6 degrees F maximum
Connection Terminal block, 1/2 inch NPT conduit hub.
Testing U.L.

Sensing Element Fluid filled probe

B. Thermostat shall be Raychem, model AMC-1A or prior approved equal.
C. Power connection kit with junction box shall be Raychem Part No. XLK-PC. Splice, end seal and tee kits shall be Raychem Part No. XLK-SET.
D. Grommets and pipe straps to suit.
E. Glass tape - 1/2 in. wide, pressure sensitive thermosetting, Raychem Part No. GT-66.
F. Pipe Labels (Electric Traced), Raychem Part No. ETL.

PART 3 - EXECUTION

3.1 PREPARATION:
A. Clean piping, valves and loose debris, and sharp edges.
B. Do not apply tracing until piping has been tested and accepted.

3.2 INSTALLATION:
A. Install cable in accordance with manufacturer's instructions.
B. Install cable in straight or spiral configuration to achieve watt design density.
C. Wrap fittings and instruments in accordance with manufacturer's standard details.
D. Do not twist bus wires together.
E. Install junction box, make terminations, splices and end seals in accordance with manufacturers instructions.
F. Install pipe labels every 15 feet on insulation jacketing after pipe is insulated.

3.3 TESTING:
A. Test each circuit twice: After cable is installed and then when thermal insulation is installed.
B. Testing shall be done with a 5000 VDC megger. Minimum insulation resistance reading shall be 20 megaohms (regardless of length). Ground fault leakage shall not exceed 3mA at rated voltage regardless of circuit length.
C. Record original values on record drawing.

END OF SECTION
SECTION 15781 - PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The work required under this section includes all work necessary for a complete installation of packaged rooftop air conditioning units.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 SUBMITTALS:

A. Shop drawings shall include complete data on compressors, gas heating components, electric motors, V-belt drives, coils, casing construction, vibration isolation, economizer cycle, and air filters.

B. Fan data shall include: capacity, fan curve, RPM brake horsepower, fly wheel effect (WK²), class, arrangement, sound power levels for each octave band.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Packaged rooftop air conditioning units shall be completely factory assembled including compressors, coils, gas heating section, refrigerant circuits, condensate drain pan, fans, motor(s), starters, filters, and controls in an insulated weather resistant casing. Units shall be rated and tested in accordance with ARI standard 360. Units shall be UL listed and labeled and classified in accordance with ANSI Z21.47 and UL 465.

B. Casing:

1. Unit casing shall be constructed of zinc coated, minimum 22 gauge, ASTM A527 G90 galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Seams shall be gasket sealed to be water tight.

2. The air handling portions of the casing shall be completely insulated with coated, fire retardant glass fiber insulation, minimum 1-1/2 inches thick. Service panels with lifting handles and air tight seal shall provide access to all sections of the unit for maintenance. The base of the unit shall be suitable for mounting on a roof curb and shall have provisions for lifting by crane.

C. Compressors:

1. Compressors shall be high efficiency, sealed hermetic rotary (scroll) or reciprocating type mounted on spring vibration isolators within the unit. Compressors shall be equipped with internal overcurrent and temperature protection as well as high and low pressure protection. Each refrigerant circuit shall have independent capillary expansion devices, service pressure ports and refrigerant line filter dries.

D. Coils:

1. Evaporator and condenser coils shall be seamless copper tube type with mechanically bonded aluminum fins. Coils shall be factory leak tested to 200 psig and pressure tested to 450 psig.
E. Fans and Blowers:

1. Evaporator fan shall be forward curved blade centrifugal type statically and dynamically balanced with adjustable V-belt drive. High efficiency motors shall be thermally protected. Fan and motor assemblies shall be spring isolated from the rest of the unit.

2. Condenser fans shall be direct drive, vertical discharge propeller type, statically and dynamically balanced. Fan motors shall be permanently lubricated with built-in thermal overload protection.

3. Powered exhaust fans shall be forward curved blade, direct drive centrifugal type. Motors shall have thermal overload protection.

F. Gas Heating Section:

1. The natural gas fired heating section shall utilize an aluminum steel drum and tube type heat exchanger with pilotless spark ignition and forced combustion blower. Safety controls shall prevent continued gas flow if spark ignition fails. Heating section shall be factory pressure and leak tested and shall bear AGA approval.

G. Filters:

1. Units shall be equipped with 2 inch thick, 30 percent efficient, pleated media type throw-away filters. Units 20 tons and larger shall also be equipped with 85 percent efficient pleated media type cartridge filters downstream of the 30 percent pre-filters.

H. Condensate Drain Pan:

1. Condensate drain pan shall be stainless steel or double wall galvanized steel with bituminous corrosion resistant coating. Pans shall be insulated on bottom side to prevent condensation.

I. Acceptable manufacturers shall include Trane, Carrier, McQuay and York.

PART 3 - EXECUTION

A. Install unit in accordance with manufacturer’s instructions.

B. Install trapped condensate drain piping from unit to discharge into roof drain or gutter (refer to detail on the drawings).

C. Turn units over to Owner with a clean set of filters.

END OF SECTION
SECTION 15855 – SPLIT SYSTEM DX AIR HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The work under this section includes all work necessary for a complete installation of air handling units.

PART 2 – PRODUCTS

2.1 GENERAL:

A. All units shall be of draw-thru design with coils, motor, blower and drain pan assembly completely within the cabinet enclosure.

B. Unit structural members shall be manufactured of 16 gauge pre-painted, galvanized sheet metal.

1. Units shall be specifically designed for indoor application with double wall construction throughout. 1" fiberglass insulation shall be installed within the space between the double wall panels.

C. Access to the blower, coils, and other items needing periodic checking or maintenance shall be through service panel with half turn latches or removable access panel.

D. Air side service access panels shall be fully gasketed.

1. Air side access panels will have an internal metal liner to protect the door insulation.

E. Unit shall have a sloped condensate drain pan with a connection provided on each side of the unit.

1. All internal wiring shall be color coded and a laminated wiring diagram shall be permanently affixed to the inside of the unit.

2.2 BLOWER ASSEMBLY

A. All belt drive blowers shall have backward inclined airfoil blades with an adjustable V-belt drive, except for the A size cabinet which has a direct drive, forward curved blade. The drive shall be provided with a minimum rating of 140% of the motor nameplate brake horsepower when the adjustable pulley is at the minimum RPM.

2.3 COILS

A. All coils shall be fabricated of seamless copper tubes with aluminum fins mechanically bonded to the tubes. Headers on the coils shall be extra heavy wall seamless drawn copper tubing with die formed end closures for added strength.

B. All refrigerant evaporators shall be designed for use with R410A and be furnished with an externally equalized, thermostatic expansion valve, factory supplied, mounted and piped. The field connections shall be made to the suction and liquid line connections furnished by the manufacturer at the side of the unit. The sensing bulb for the expansion valve shall be field installed on the suction line immediately outside of the air handler cabinet.

2.4 HOT GAS REHEAT

A. The unit shall include a hot gas reheat coil with a modulating reheat control valve and an electronic controller. The valve position shall be controlled to provide a specific supply air
temperature setpoint that is set on the control board or sent to the control board by a remote 0-10 Vdc signal.

2.5 FILTERS
   A. The unit shall be furnished with 2 inch (4 inch) thick, pleated air filters. Filters shall be removable from the side of the cabinet.

2.6 ELECTRICAL CONNECTION
   A. Each unit shall have a single point power connection terminal block for field connection to the electrical power source.
   B. Each unit shall include a 24 volt control circuit transformer and a fan contactor for operation of the blower motor.

2.7 ELECTRIC HEATING
   A. When the unit is specified to contain electric heating, the unit manufacturer shall supply the electric resistance heating assembly with the capacity and number of steps as listed in the schedule. All heating elements shall be open wire type with nichrome wire mounted in ceramic insulators. The heater element(s) shall be controlled by a 24 volt normally open contactor(s). The assembly shall be furnished with proper internal components to continue to allow the unit to have a single point power connection and shall bear the ETL listing label.

2.8 ACCEPTABLE MANUFACTURERS:
   A. Aaon, Desert Aire and Addison.

PART 3 - EXECUTION
   A. Install unit in accordance with manufacturer’s instructions.
   B. Install full size condensate drain piping from unit to air gap fitting location shown on plan. Drain line shall be installed with a slope of not less than 1/8 inch per foot down in the direction of flow.

END OF SECTION
SECTION 15870 - POWER VENTILATORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
A. This specification describes the requirements for labor and materials necessary for the installation of power ventilators included as part of the building mechanical system.
B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 SUBMITTALS:
A. Submit catalogue literature pertaining to the power ventilator listed within his Section to Architect/Engineer for approval.
B. Submittals shall include dimensional information, electrical connection and motor data, list of accessories or auxiliary items and roof curb details and dimensions.
C. Submittals shall include sound power levels at the mid frequency of each band.

PART 2 - PRODUCTS

2.1 GENERAL:
A. Power ventilators which are scheduled or referred to by model number or catalogue number are intended to include all materials covered by such number. Any required accessories for the installation of the fan are to be by the same manufacturer unless otherwise noted.
B. All wiring and electrical components shall comply with the National Electric Codes (NEC). All materials shall be U.L. Listed.
C. Each unit shall have a birdscreen constructed of galvanized wire mesh with 1/2 in. openings mounted vertically in the unit discharge. The birdscreen shall produce minimal effect on air and sound performance.
D. Roof Curbs:
   1. Curbs shall be constructed using minimum 14 gauge galvanized steel with fully mitered and welded corners, integral base plates internally reinforced with 1 in. x 1 in. x 1/8 in. steel angle, factory insulated with 1 1/2 in. thick three pound per cu. ft. density fiberglass insulation. Curbs shall be fabricated without cants. Curbs shall be Custom Curb, Inc., Louvers and Dampers or ThyCurb. Minimum height of curb shall be 8 in. above finished roof. Curbs shall be constructed to match slope of roof and provide a level top surface for mounting of mechanical equipment.
E. Back Draft Damper:
   1. Back draft damper shall be 6063T5 extruded aluminum frame, .025 in thick formed aluminum blades, extruded vinyl edge seals, synthetic bearings, mill finish. Leakage shall be limited to 12cfm per square foot at 1/2 in. W.G.
   2. Damper shall be Ruskin BD2/A1 or approval equal.
2.2 CENTRIFUGAL ROOF EXHAUSTER:

A. Belt - Driven:

1. Fans shall be centrifugal belt driven type. The fan wheel shall be non-overloading centrifugal backward inclined, constructed of aluminum. Wheels shall be statically and dynamically balanced.
2. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.
3. Motors shall be TEFC heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance.
4. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
5. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.
6. A NEMA 1 disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.
7. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
8. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number.
9. Fans shall be Model GB as manufactured by Greenheck Fan Corporation. Loren Cook and Breidert are approved equals.

2.3 UPBLAST CENTRIFUGAL ROOF EXHAUSTER – GREASE FAN PROVIDED BY OTHERS.

2.4 INLINE CABINET EXHAUSTER:

A. Fans shall be inline type, direct drive, forward curved blade centrifugal type with integral backdraft damper. Fan wheels shall be statically and dynamically balanced. Galvanized steel fan scroll shall be of lock seam construction.

B. The Fan Cabinet shall be constructed of heavy gauge galvanized steel, lined with 1/2 inch thick fiberglass acoustical insulation. A removable access panel shall provide easy access to the motor and fan for service. The cabinet shall have duct collars at the inlet and outlet connections and an integral gravity type backdraft damper.

C. The motors shall be shaded pole, permanently lubricated type with thermal overload protection, resiliently mounted on vibration isolators. Electrical disconnect shall be plug-in type. An electrical access cover located on the cabinet housing shall allow for external wiring.

D. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number identification. Fans shall be Model SQ as manufactured by Greenheck Fan Corporation. Loren Cook, Carnes, and Breidert are approved equals.
PART 3 - EXECUTION

3.1 INSTALLATION:

A. Curbs shall be installed in strict accordance with manufacturer's printed instructions and as detailed on the drawings.

B. Install fan and back draft damper in accordance with manufacturer's installation instructions.

END OF SECTION
SECTION 15892 - LOW PRESSURE DUCTWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. The work required under this section includes all work necessary for a complete installation of ductwork and accessories.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.2 CODES AND STANDARDS:

A. Sheet Metal and Air Conditioning Contractors National Association
   1. HVAC Duct Construction Standards: Metal and Flexible
   2. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

B. National Fire Protection Association:
   1. 90A - Installation of Air Conditioning and Ventilating Systems
   2. 90B - Warm Air Heating and Air Conditioning System
   3. 96 - Standard for the Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment
   4. 101 - Code for Safety to Life
   5. American Society of Heating Refrigerating and Air Conditioning Engineers

1.3 SUBMITTALS:

A. Submittals (for each duct system) shall include: duct shop fabrication standards indicating gauges, joint and reinforcement spacing, type of reinforcement, elbow fabrication, splitter damper and duct tap details, flanges, hangers and rod sizes, duct liner details, etc.

B. Submittals shall include testing or listing certification, dimensional data and manufacturer’s literature on all manufactured products.

PART 2 - PRODUCTS

2.1 GENERAL

A. Ductwork shall be fabricated from sheet metal products conforming to the following material standards:

   1. Galvanized Steel - ASTM A525, A 526 and A527(G60)
   2. Aluminum - ASTM B 209 3003
   3. Low Carbon - Commercial Quality ASTM A-366

B. Duct system shall be fabricated with sheet metal thicknesses and reinforced in accordance with SMACNA.

C. Unless noted otherwise the minimum pressure/velocity classification shall be 2 inch W.G. plus or minus, at 2500 ft. per minute, duct seal class "A".

D. Ducts 18 inches and larger on any side shall be stiffened by beading on not to exceed 12 inch centers.
2.2 GALVANIZED STEEL DUCTWORK:

A. All junctions, bends, turns or elbows in all ducts or risers shall have a large radius (centerline radius equal to 1-1/2 times duct width) in the throat in order to minimize the frictional resistance. Vanes shall be provided in elbows with 90 degree throats and throat radii less than 1-1/2 times duct width, and shall be located in accordance with ASHRAE standards. Double-vane airfoil-type turning vanes shall be provided for all square turns.

B. Exposed galvanized steel duct work shall be surface treated for painting.

C. All longitudinal seams shall be grooved, double or Pittsburgh type.

D. Branch connections in supply ducts shall be fabricated per the following schedule:

<table>
<thead>
<tr>
<th>Maximum Branch Size</th>
<th>Branch Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to, Rectangular equivalent to 12</td>
<td>45 deg. tap collar with</td>
</tr>
<tr>
<td>inch round</td>
<td>volume damper in branch</td>
</tr>
<tr>
<td>All other duct branches</td>
<td>Proportioned duct, with</td>
</tr>
<tr>
<td></td>
<td>adjustable splitter damper</td>
</tr>
</tbody>
</table>

E. Branch connections in return or exhaust ductwork shall be made with 45 degree entry fittings. If ducts are the same depth use parallel branch connection.

F. Where acoustical or thermal insulation is applied on the inside of ductwork, size of ductwork shall be increased so that the duct size shown on the drawings are the dimensions of the inside of the insulation.

G. Ductwork outside the building shall be fabricated of not less than no. 16 gauge galvanized steel.

2.3 ALUMINUM DUCTWORK: (Dishwasher Ductwork)

A. All longitudinal seams shall be grooved, double or Pittsburgh seams, completely heliarc welded. Field transverse seams shall be companion flange, gasketed with neoprene gaskets and bolted. Flanges shall be constructed using Van Stone type flanged with duct ends turned up and lapped approximately 3/4 inch with a galvanized steel angle over each duct end.

B. Cross-breaking, supports, elbows, etc., shall be the same as specified for galvanized steel ductwork, except that material shall be constructed of aluminum.

C. All reinforcements shall be aluminum.

D. Ducts shall be fabricated from .050 inch thick aluminum and shall be reinforced at joints and at intermediate points not exceeding 2 ft. 0 inch. Reinforcement shall be not less than 1-1/8 inch x 22 ga. standing drive slips, and 1 inch 26 ga. standing "S".

E. Entire system of ductwork, including all vertical sections, shall be heliarc welded as specified above to be watertight.

F. All exposed ductwork in finished areas shall be constructed of aluminum including companion angle flanges. Hangers shall be stainless steel.

G. All duct surfaces that contact uncoated steel or copper shall be di-electrically isolated with two coats of zinc chromate paint, one layer of asphalt impregnated paper, or one
coat of bituminous paint.

2.4 KITCHEN EXHAUST DUCTWORK:

A. Ductwork shall be not less than 16 ga carbon steel. Ductwork shall be welded continuous liquid tight. Ducts shall have welded longitudinal seams and welded flanged joints. All fastenings (e.g. hanger straps) shall be welded.

B. Elbows shall be smooth, long radius type (1-1/2 duct centerline radius).

C. 20 in. x 20 in. access door openings shall be flanged welded type with mitered corners and stainless steel studs. Outstanding leg of flange shall be not less than three inches from duct surface.

D. Access doors (not less than 16 ga) shall be gasketed with stainless steel wing nuts fasteners on two inch centers. Door gaskets shall be rated for 1500 degrees F.

2.5 MISCELLANEOUS:

Trapeze Hangers - ASTM A 36 Structural Steel
Hanger Rod - ASTM A 36 or A 575 Threaded Hot Rolled Steel

A. Duct Sealer: Solvent or water based type U.L. classified meeting NFPA 90A Class 1 with zero fire and smoke development rating. Sealer shall be United Sheet Metal, United Duct Sealer, or Hardcast Iron Grip No. 601.

2.6 FLEXIBLE CONNECTORS:

A. Flexible connectors shall be U.L. listed, neoprene coated heavy glass fabric. Fabric shall be Ventglas, manufactured by Ventfabrics, Inc.

2.7 FLEXIBLE DUCTWORK:

A. Flexible duct shall be UL listed and labeled as Class 1, Air Duct Connector, in accordance with U.L. Standard 181 and shall meet the requirements of the latest NFPA Bulletin, No. 90A and No. 90B for flame spread and smoke development rating.

B. Flexible duct shall be rated for a maximum pressure of 6 inch positive and 3/4 inch negative and 4000 fpm maximum velocity. Air duct shall consist of: CPE liner, coated spring steel wire helix, fiberglass insulating blanket, fiberglass scrim and polyethylene film vapor barrier. Thermal conductance shall be .23 or less.

C. Duct shall be Thermaflex G-KM, CertainTeed Certaflex G.25 or prior approved equal.

2.8 ACOUSTICAL AND THERMAL DUCT LINER:

A. Acoustical and thermal duct liner shall be 1 inch thick Certain-Teed or Owens-Corning Aeroflex type 300 monolithic constructed, long glass fiber insulation with uniform density with the following acoustical efficiency:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1,000</th>
<th>2,000</th>
<th>4,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>.16</td>
<td>.53</td>
<td>.41</td>
<td>.60</td>
<td>.84</td>
<td>.87</td>
</tr>
</tbody>
</table>

B. Insulation and adhesives shall comply with the requirements of NFPA-90A (latest edition) as to flame spread and smoke development ratings. Liner shall meet the Erosion Test Method described in UL Publication No. 181.

C. Insulation shall be secured to all duct surfaces by firmly pressing into wet adhesive
applied to 100 percent of the duct surface. In addition, insulation on top, bottom and sides of horizontal ducts and all sides of vertical ducts shall be held in place with insulpins welded to duct on 12 to 18 inch centers and with clips slipped over the pins.

2.9 DAMPERS AND DEFLECTORS

A. Single Blade Dampers:

1. Single Blade Dampers shall be constructed of 22 gauge galvanized steel (blade and frame). Single blade dampers shall be limited to a 12 inch high blade. Blade edges shall be crimped or reinforced. Damper levers shall indicate positively the open and closed position. End bearings shall be molded synthetic. Dampers shall be Ruskin MD25 or approved equal (Ruskin MDRS25 for round ducts).

B. Multiblade Dampers:

1. Multiblade dampers shall be constructed of sheet metal the same material as the adjacent ductwork. Damper frame shall be not less than 16 ga., damper blades not wider than 6 inches shall be the same material as the frame. Damper edge seals shall be EPDM, joint seals shall be metal compression type. Damper leakage shall be limited to 10 cfm per sq. ft. at 4 inch W.G. when tested in accordance with AMCA Standard 500. Dampers shall be Ruskin CD36 or prior approved equal.

C. Hinged Deflector:

1. Deflectors shall be Titus Volume Extractor model AG-225.

D. Fire Dampers (1-1/2 Hr):

1. Fire dampers shall be Underwriters approved and labeled (UL555). Fire dampers shall be Ruskin, IBD series for rectangular ducts, FD series for large openings, and FDR for round ducts. Dampers shall be fabricated of galvanized steel and shall be of such a design and length as to function as a wall mounting sleeve, which shall be a part of the fire damper. Sleeves shall be of welded or bolted construction. Crimping or tabs will not be acceptable substitutes for welding or bolting.

2. Air Balance and Prefco are approved equals.

E. Counter Balanced Backdraft Damper:

1. Dampers shall have 14 gauge galvanized steel channel frame, 8 inches wide 16 gauge galvanized steel blades, 1/2 inch diameter plated steel axles, ball bearings, neoprene blade seals and jamb seals.

2. Dampers shall be Ruskin CBS7, Air Balance or Prefco.

2.10 DAMPER HARDWARE:

A. All hardware shall be SMACNA accepted. Standard hardware shall be used on galvanized steel ductwork; stainless steel hardware shall be used on stainless and aluminum ductwork.

B. Insulated ductwork (concealed) - Ventlok 638 elevated dial regulator.

C. Insulated ductwork (exposed) - Ventlok 644 - self locking regulator.

D. Uninsulated ductwork - Ventlok 555 or 560 Quadrants.
2.11 ACCESS DOORS:

A. Access doors shall be hinged, constructed of the same material as the ductwork. Door edges shall be sealed with 3/4 inch wide x 1/8 inch thick neoprene sponge gasketing. Door hardware shall be Ventlok #100 latches. Access doors on insulated ductwork shall be double wall construction with 1 inch of rigid 3 PCF fiberglass insulation.

B. Access doors shall be approximately 18 inches high by 24 inches wide. In smaller ductwork, the height shall be reduced to be 2 inches less than that of the ductwork.

PART 3 - INSTALLATION

3.1 GENERAL:

A. Ductwork hangers shall be supported by drilled anchors into concrete slabs.

B. Provide angles (same material as duct) at points where duct penetrates walls, to close off space between wall opening and duct.

C. Provide supports from roof or wall brackets for ductwork mounted outdoors.

D. Duct material and pressure classes have been identified on the drawings. Any duct shown on the drawing but not identified shall be low pressure galvanized steel. (2 inch W.G. 2500 fpm).

E. Install smoke detectors in ductwork. Smoke detectors will be furnished by the Division 16.

F. Repair fire proofing which was removed for ductwork installation. Installation to be done by an approved qualified tradesman.

G. Suspend horizontal ducts on not to exceed 6 ft. spacing by galvanized steel straps 1 inch x no. 16 ga. for sizes up to 60 inch width, 1-1/2 inch x no. 16 ga. for sizes up to 96 inch width, and 2 x 2 x 1/4 inch trapeze shelf angles for ducts wider than 96 inches. Unless noted otherwise straps shall be fastened to sides of ducts with not less than two sheet metal screws. Bottom ends of straps shall hook 2 inches under ducts and be secured with a sheet metal screw through bottom of ducts (except watertight ducts).

H. Vertical ducts up to 60 inches shall be supported at each floor by 1-1/2 x 1-1/2 x 1/8 inch steel angles resting on floor or steel framework and secured to duct with sheet metal screws; above 60 inch 2 x 2 x 1/8 inch steel angles.

I. Watertight ductwork shall be supported on trapeze hangers soldered or welded to the duct. Vertical ducts shall have brackets welded or soldered to the ducts.

J. Watertight ductwork shall be pitched to drain out of grilles or other inlets. At base of risers, at low points and any other locations where water may collect, provide drains consisting of 3/4 inch type L copper tubing with soldered fittings extended to suitable drain location.

K. Support vertical ductwork or risers at every floor. Provide structural steel framing channels or wide flange shapes in shaft openings to support ductwork.

L. Water and other pipes shall not be allowed to pass through air risers or ducts, unless approved by the Engineers, and when this occurs, the size of said duct or riser shall be proportionately increased. Sanitary waste and vent piping shall not penetrate any ductwork.
3.2 KITCHEN EXHAUST DUCT:
   A. Access openings shall be provided on the sides or tops of duct.
   B. Provide access openings at each kitchen hood, at exhaust fan, every 12 ft. on straight ducts, and at each elbow.
   C. Access doors shall be mounted 1 1/2 in. from the bottom of the duct.
   D. Duct shall slope at not less than 1 in. per foot toward hoods.

3.3 DUCT SEALER:
   A. All ductwork shall be as airtight as possible. Transverse seams shall be taped and sealed with two layers of United Sheet Metal, Uni-Cast or caulked with duct sealer.

3.4 FLEXIBLE CONNECTORS:
   A. Install flexible connectors at all supply and exhaust fans and other air handling units with inlet and outlet duct or casing connections.
   B. Connectors shall be suitable for the pressure of the units involved and shall be sealed airtight.
   C. Connectors shall be not less than 4 inches long (in clear) and properly attached to duct and fan connection collar by 1 x 1/8 inch draw band (fabricated of the same material as adjacent ductwork) firmly clamped around collars in such a manner as to be airtight and secured to collars with sheet metal screws. Connectors shall not be painted.
   D. Connectors shall not be used as transition pieces between fan and ductwork.

3.5 FLEXIBLE DUCTWORK:
   A. Flexible ducts shall be used for straight runs of duct or offsets up to 45 degrees, but not exceeding 48 inches in length. The use of flexible ducts as elbows with more than a 45 degree bend will not be permitted.
   B. Flexible ductwork shall be secured to rigid ductwork and unit openings by sliding the flexible duct over the rigid duct, sealing with an approved adhesive, clamping with a suitable clamp and taping.

3.6 ACOUSTICAL AND THERMAL DUCT LINER:
   A. Sheet metal duct shall be 2 inches greater in both dimensions than that indicated on drawings. Provide sheet metal lagging strip securely attached to duct to protect ends of insulation.

3.7 DUCT ACCESS DOORS:
   A. Provide duct access doors at all duct mounted devices requiring adjustment or resetting (e.g. smoke dampers, fire dampers), at all ducted fan inlets, at the up-stream side of all ducted filters, at the upstream side of all air measuring stations.

3.8 DAMPERS:
   A. Install dampers where shown or called for on the drawing. Install damper operating hardware.
B. Fire dampers and smoke dampers shall be installed in accordance with manufacturer’s instructions. Install style A fire dampers behind ducted grilles and registers in rated walls. Install style B or C fire dampers in ducted openings in rated walls.

3.9 DEFLECTORS:
A. Fixed deflectors shall be installed in low pressure ductwork at supply grille and register connections, and where indicated.

3.10 TESTING:
A. The first 100 lin ft. section of ductwork installed shall be tested for leakage. Ductwork shall be tested at the duct pressure class (positive or negative depending on duct service), leakage shall be limited to 8 percent.

B. Owner may request additional tests at any time up to the time outlet devices or insulation is installed. Cost of additional testing will be paid by Owner; cost of repairing leaks and retesting shall be at no additional cost to the Owner.

3.11 LOUVERS:
A. Make connections to louvers. Where duct size is less than full louver opening, close off remaining unused louver opening with an insulated panel assembly consisting of 24 ga galvanized sheet metal screwed to the louver, 2 in. thick 3 PCF fiberglass rigid board and covered with a 22 ga galvanized sheet metal outer skin. Seal all openings.

3.12 OUTDOOR DUCTWORK
A. Slope ductwork to prevent water accumulating on ducts. Duct slope shall be a minimum of 1:24.

END OF SECTION
SECTION 15906 - TEMPERATURE CONTROLS (ELECTRIC)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The work included in this specification consists of furnishing all labor, material, accessories and equipment necessary for the temperature control system.

B. The work of this section is subject to the requirements of the Mechanical General Provision.

1.2 CODES AND STANDARDS:

A. Furnish and install an electric system of automatic temperature control as specified herein and as shown on the Contract drawings as manufactured by TCS Basys.

B. Extra costs incurred by use of other than base bid control system, such as wiring, contract drawings changes, changes in design, added supervision, etc., shall be the responsibility of the Temperature Control Sub Contractor (TCSC).

1.3 SUBMITTALS:

A. System documentation shall include the following:

1. Manufacturer's data sheets of all products (original copies).
2. Complete description of operation of all control loops, including recommended setpoints and ranges of adjustment.
3. Fully labeled elementary diagram (electrical ladder diagram).
4. Lists of all proposed devices and equipment.

PART 2 - PRODUCTS

2.1 ELECTRIC ACTUATORS:

A. Motor Operators:

1. Motor operator shall be spring return type, which returns motor actuator shaft to its full normal mechanical travel upon power failure. Damper motor drive mechanism will include holding brake to keep the return spring from drawing the actuator from driving toward its normal position unless power is interrupted.
2. Motor actuator shall operate from a SPDT on/off control.
3. Rotational travel shall be 45 degrees to 270 degrees.
4. Voltage: 24 volts AC.
5. Operating speed: 60 seconds for 160 degrees travel.
7. Unit shall be available with mounting brackets, shaft linkage assemblies, and end switches.
8. Unit shall be Honeywell S0524 – 2 position direct coupled spring return actuator or prior approved equal.

2.2 AUTOMATIC DAMPERS:

A. All control dampers shall be standard products of damper or temperature control manufacturers unless noted otherwise.
B. Local fabrication of dampers is not allowed.

1. Damper frames: 16 gauge galvanized steel.
2. Blades: Not over 6 inches wide nor less than 22 gauge galvanized steel roll formed, with stainless steel shafts.
4. Linkages: Galvanized steel, exposed type.
5. Side seals: Stainless steel of the tight-seal spring type.
6. Dampers and seals suitable for temperature ranges of -40 to 200 degrees F.
7. Dampers shall be opposed blade type, and the Contractor shall submit construction data for all control dampers with the temperature control submittal.

C. Dampers shall be Ruskin.

2.3 THERMOSTATS:

A. Wall thermostats shall be commercial programmable thermostats and control up to three stages of cooling and three stages of heating. Thermostats shall be adjustable heating and cooling, with visible display of room temperature in °F or °C. Provide configurable Proportional plus Integral plus Derivative temperature control. Provide automatic heat/cool change over with 2 °F minimum deadband.

B. Thermostats to have a 365 day programming with schedule copy. Provide 365 day clock with automatic daylight savings changeover and up to 10 holidays. Provide override capability for 1 to 8 hour configurable period with 3 hour default. Include a comfort adjust feature to modify setpoints for override duration.

C. Unit shall be provided with a remote space sensor. Units to be provided with auxiliary relays for interlocking exhaust fans and outside air dampers.

D. Provide ability to calibrate the sensor.

E. Thermostat shall operate on 24 volt AC power and shall be Honeywell T7350H Commercial Programmable thermostat with sub-base. Provide a 48 hour backup battery. Provide sequential start after power failure.

F. Unit shall be provided with appropriate sub-base.

2.4 TEMPERATURE CONTROL WIRING:

A. All control wiring and conduit required to complete the temperature control system shall be installed by the Temperature Control Sub-Contractor in accordance with the Electrical Specifications Section 16.

PART 3 - EXECUTION

3.1 GENERAL:

A. Provide a complete system of automatic temperature regulation applied to the air conditioning, heating and exhaust system.

B. The entire control system, including low voltage wiring, with the exception of automatic dampers, shall be installed by the temperature control contractor, who shall make all tests and adjustments. All controls shall be field-tested and field-calibrated.
C. Set points of all controlling instruments are indicated at a specific point; however, all set points shall be adjustable up and down from the point indicated.

D. Install duct-mounted smoke detectors where shown on plans.

3.2 ELECTRIC ACTUATORS:
A. Supply and install electric motor operators for all dampers. Motors shall be spring to open, energize to close.

3.3 AUTOMATIC DAMPERS:
A. Supply for installation by the Mechanical Contractor all motor operated dampers per the specifications of this Section.

3.4 SEQUENCE OF OPERATION:
A. Packaged Rooftop Units- DX cooling/- Gas Heating
   1. Unit to be controlled by space thermostat equivalent to Honeywell T7350H Commercial programmable thermostat.
   2. Occupied Mode: Fan is to run continuously and outside air damper open. On a rise in space temperature above set point, bring on single or multiple stage of cooling. On a drop in space temperature below set point, bring on first stage of heating; on continual drop in space temperature, bring on second stage of heating.
   3. Dehumidification Mode: Units equipped with dehumidification cycle shall enable full cooling on a rise in space humidity above setpoint, heating shall be enable based upon the space temperature.
   4. Un-occupied Mode: Fan is to cycle with a call for heat or cooling. Outside air damper to remain closed.
   5. Safeties/Interlocks: Unit to be shut down on alarm from duct smoke detectors. Cooling and Heating operation shall be interlocked with the supply fan operation. The time clock feature of the thermostat shall be utilized to control all associated exhaust fans.

B. Split System- DX cooling/- Electric/Heat Pump
   1. Unit to be controlled by space thermostat equivalent to Honeywell T7350H Commercial programmable thermostat.
   2. Occupied Mode: Fan is to run continuously and outside air damper open. On a rise in space temperature above set point, bring on single or multiple stage of cooling. On a drop in space temperature below set point, bring on first stage of heating; on continual drop in space temperature, bring on second stage of heating.
   3. Dehumidification Mode: Units equipped with dehumidification cycle shall enable full cooling on a rise in space humidity above setpoint, heating shall be enable based upon the space temperature.
   4. Condensing Unit: The outdoor condensing unit shall have its compressors enabled and cycled to maintain the space temperature. Units equipped for heat pump operation shall have the first stage of heating be the reversing valve and compressor operation. Additional stages of heating shall be the electric heat.
   5. Un-occupied Mode: Fan is to cycle with a call for heat or cooling. Outside air damper to remain closed.
   6. Safeties: Unit to be shut down on alarm from duct smoke detectors. Cooling and Heating operation shall be interlocked with the supply fan operation.
C. Electric Unit Heaters:

1. Units to be controlled by space thermostat equivalent to Honeywell T72 Round heating only thermostat.

3.5 DRAWINGS:

A. TCSC shall furnish to the Engineer for approval, before commencing work on the system, blueprints of schematic control diagrams, including revised control diagrams from the original building.

B. At the completion of the job, TCSC shall correct his drawings to include any changes made during construction.

3.6 ELECTRIC WIRING:

A. Electric connections between the various unit control cabinets shall be made by the TCSC. All wiring must be tagged on both ends with panel number and terminal number.

B. The TCSC shall also furnish and install all wiring to equipment furnished by him if such wiring is not shown.

C. TCSC shall furnish and install all conduits, raceways, etc., required. TCSC shall furnish and install all control and interlock wiring. All wiring shall conform to standards and specifications outlined in Section 16100. Wire size shall be in accordance with manufacturer's recommendations and National Electric Code. Minimum conduit shall be 1/2 inch diameter. TCSC shall furnish and install all required auxiliary starter contacts or relays, etc., for a complete electrical interlock and control wiring system.

3.7 OPERATION TEST:

A. At completion, TCSC shall operate the system for a period of at least three days of eight hours each on the new systems to demonstrate fulfillment of the requirements of the contract. During this time, all adjustments shall be made to the equipment so that it is in first-class operating condition. The entire system is to be left in operating condition acceptable to the Engineer.

3.8 OWNER'S INSTRUCTION:

A. Upon completion of the work and acceptance by the Owner, TCSC shall provide one scheduled four-hour period of formal instruction to the Owner's operating personnel who have responsibility for the mechanical system.

END OF SECTION 15906
SECTION 15936 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
   A. This specification describes the air distribution outlets, exhaust and return air devices, and the accessories required for complete installation.
   B. The work of this section is subject to the requirements of Mechanical General - Section 15010.

1.2 CODES AND STANDARDS:
   A. Sheet Metal and Air Conditioning Contractors National Association
      1. HVAC Duct Construction Standards - Metal and Flexible
   B. American Society of Heating, Refrigerating and Air Conditioning Engineers
   C. Air Conditioning and Refrigeration Institute
      1. ARI 890-1994 Rating of Air Diffusers and Air Diffuser Assemblies
      2. ARI 885-1990 Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
   D. International Organization for Standardization (ISO)
      1. ISO 5219-1984 Air Distribution and Air Diffusion -- Laboratory Aerodynamic Testing and Rating of Air Terminal Devices
      2. ISO 5135-1984 Acoustics -- Determination of Sound Power Levels of Noise from Air Terminal Devices, High/Low Velocity/Pressure Assemblies, Dampers and Valves by Measurement in a Reverberation Room.

1.3 SUBMITTALS:
   A. Submittals shall include manufacturers technical literature for performance (sound pressure loss, throw) pictorial literature, and schedule shall be submitted indicating the style and size of each diffuser or grille, location by room number, CFM of unit, throw, noise level, (NC rating) method of mounting and finish.
   B. Submittals for operating room diffusers shall include Test Dates as specified.

1.4 ACCEPTABLE MANUFACTURERS:
   A. Acceptable Manufacturers shall be Titus, Anemostat, Krueger, and Carnes.
PART 2 - PRODUCTS

A. General

2. Exhaust grilles and registers including volume controllers for toilet rooms and janitors’ closets, shall be constructed entirely of aluminum. Except where aluminum is specified, remainder of diffusers, grilles and registers may be constructed of steel including volume controllers.
3. Grilles and frames constructed of aluminum shall have a 60 minute anodized aluminum finish. All other grilles and diffusers shall have a white flo-coat finish suitable as a finish coat or for field painting.
4. Refer to architectural drawings for the various types of ceilings, i.e., mineral tile or plaster to assure that air devices have the correct type of mounting. Refer to drawings of reflected ceiling plans for location of ceiling diffusers and grilles.
5. Supplier shall also check all air distribution and return air devices for proper performance, noise and accessories. Any device exceeding noise level herein specified shall be brought to the attention of the Engineers.
6. Contractor shall coordinate openings in hard ceilings, furred walls, masonry walls, and floors.
7. The nominal or duct connection size of grilles (not overall dimensions) is given on plans.
8. Mounting frames shall be provided for all grilles and registers mounted in drywall, plaster, concrete or masonry openings.
9. Devices are defined in the following manner in this section.

<table>
<thead>
<tr>
<th>Device</th>
<th>Abbreviation used on the Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Diffuser</td>
<td>CD</td>
</tr>
<tr>
<td>Supply Grilles</td>
<td>SG</td>
</tr>
<tr>
<td>Return Grilles</td>
<td>RG</td>
</tr>
<tr>
<td>Exhaust Grille</td>
<td>EG</td>
</tr>
</tbody>
</table>

10. A third letter following these abbreviations refers to the type of device which is defined herein.

B. Ceiling Diffuser:

1. Type B Perforated shall be Model PAS-Type 1, surface mounted with round neck) or PAS-Type 3 (lay-in frame with round neck). Removable face with field adjustable baffles and Model AG-75 opposed blade damper and EG equalizing grid.
2. Type A Square and Rectangular Louvered Face - 1-4 way, shall be Titus model TDC-Type 1 (surface) or TDC-Type 3 (lay-in). Removable core, square or rectangular neck, with air pattern shown on the drawings. Diffusers shall be furnished with AG-95 opposed blade damper and EGS equalizing grids.
3. Type C Titus model TDC-FR (Fire-rated).

C. Supply Grilles and Registers:

1. Type A - Titus model 300RL double deflection grilles with horizontal face bars on 3/4 inch spacing.
D. Exhaust/Return Grilles:

1. Type A - Titus model 50F, 1/2 inch aluminum grid for. Register shall include an AG-35 opposed blade damper.
2. Type B – Titus model PAR-FR (Fire-rated).

PART 3 - INSTALLATION

A. Provide air devices as indicated on the drawings. Mount each device securely to avoid rattling and vibration.

B. Devices shall be parallel to the plane of the surfaces they are mounted on.

C. Continuous linear devices shall be aligned, parallel to walls, with no perceptible distortion.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The work in this section defines the minimum requirements for the operation of the DCS.
B. The work of this section is subject to the requirements of Mechanical General Section 15010.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION (DDC)

A. General:

1. This section refers to the operation of the elephant building. The operation of the cafe and the restroom building controls is by programmable thermostats.

3.2 VENTILATION (EF-5, 6, 7, 8, 9, AND 10)

A. General

1. The fans shall be controlled through the Hand-Off-Auto switch.
2. In the automatic cooling mode the exhaust fans shall energize when called upon by the wall mounted thermostat (78°F, adjustable). When any of the exhaust fans are operating the motor operated damper at the intake louvers shall open. When the exhaust fans shut down the intake louver dampers shall close.
3. In the automatic ventilation mode (ambient temperature < 65°F, adjustable) the exhaust fans shall energize in five (5) minute intervals every fifteen (15) minutes.
4. In the automatic ventilation mode (ambient temperature > 78°F, adjustable) the exhaust fans shall energize until the temperature is satisfied.

3.3 RADIANT HEATERS (ELEPHANT LAIR):

A. The radiant heaters shall energize upon a call for heating (59°F, adjustable, for the herd room and holding room and 74°, adjustable, for the isolation room) from the associated space mounted thermostat. Upon a further call for heating (55°, adjustable, for the herd room and holding room and 70°, adjustable, for the isolation room) the second stage of heating shall be energized.

3.4 HYDRONIC FLOOR HEATING:

A. From a call for heating from the slab sensor (90°F, adjustable) the hot water pump shall energize. The hot water pump shall shut down when the slab temperature is satisfied (100°F, adjustable)

3.5 RADIANT HEATERS (PAVILION AND WEST PATIO)

A. The radiant heaters shall energize upon a call for heating (60°F, adjustable) from the associated temperature sensor.

3.6 CAFE AIR CONDITIONING UNITS (AC-1 and AC-2)

A. Occupied Mode
1. The air conditioning unit mounted outside air damper and the supply fan shall energize when sent a signal from the space mounted thermostat time clock.

2. Upon a call for cooling (75°F, adjustable) from the space mounted thermostat the compressors shall energize in sequence.

3. Upon a call for heating (68°F, adjustable) from the space mounted thermostat the unit mounted gas heater shall energize and modulate to maintain space setpoint.

B. Unoccupied Mode

1. Upon a call for cooling (85°F, adjustable) from the space mounted thermostat the supply fan shall energize with the unit mounted outside air damper in the closed position and the compressors shall energize in sequence.

2. Upon a call for heating (50°F, adjustable) from the space mounted thermostat the supply fan shall energize with the unit mounted outside air damper in the closed position and the unit mounted gas heater shall energize.

3.7 RESTROOM AIR CONDITIONING UNIT (AC-3)

A. Occupied Mode

1. The air conditioning unit mounted outside air damper and the supply fan shall energize when sent a signal from the space mounted thermostat time clock.

2. Upon a call for cooling (75°F, adjustable) from the space mounted thermostat the compressors shall energize in sequence.

3. Upon a call for heating (68°F, adjustable) from the space mounted thermostat the unit mounted gas heater shall energize and modulate to maintain space setpoint.

3.8 RESTROOM BUILDING EXHAUST FANS (EF-1, 2, 3, AND 4)

A. Occupied Mode

1. The exhaust fan shall energize upon a signal from the AC-3 thermostat timeclock.

END OF SECTION
SECTION 15991 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

A. This section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing (T/A/B) as required to meet design specifications, plus recording and reporting the results.

B. The work of this section is subject to the requirements of the Mechanical General Section 15010.

1.1 DESCRIPTION OF WORK:

A. Prior to acceptance and before final inspection, test and balance the air and water systems as listed herein and as specified hereinafter and submit reports as specified hereinafter.

B. The mechanical contractor has numerous responsibilities associated with the test and balance, it is imperative that the test and balance contractor coordinate these responsibilities with them.

C. Test, adjust, and balance the following mechanical systems:

1. Supply air systems, all pressure ranges:
2. Return air systems;
3. Exhaust air systems;
4. Hydronic systems;
5. Verify temperature control system operation.
6. Test systems for proper sound and vibration levels.

D. This Section does not include:

1. Testing boilers and pressure vessels for compliance with safety codes;
2. Specifications for materials for patching mechanical systems;
3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

1.2 QUALITY ASSURANCE:

A. Applicable publications: The following publications form a part of this specification, to the extent that they represent minimum standards. Where this specification exceeds these standards, this specification shall be followed.

B. Associated Air Balance Council (AABC) National Standards or Field Measurement and Instrumentation, latest edition.


E. National Environmental Balancing Bureau (NEBB)

1.3 QUALIFICATIONS FOR TEST AND BALANCE CONTRACTOR:

A. The test and balance contractor shall be an independent contractor that regularly performs air and water systems testing and balancing. Minimum qualifications for acceptance shall be general membership in NEBB or AABC, except that affiliation with manufacturers, installing, contractors, or engineering firms may not preclude acceptance.

B. Supervisor directly in charge of the water and air testing and balancing work shall be a registered professional engineer, in the state where the project is located, with not less than five (5) years experience in the mechanical contracting industry and not less than two (2) years experience in testing and balancing of heating, ventilating, and air conditioning systems. The supervisor shall stamp the title page of the test and balance report with his professional engineer's stamp.

C. The supervisor and the lead test and balance mechanic shall be certified as test and balance technicians by one or more of the following groups, AABC, NEBB, SMACNA, ASHRAE, or the Sheet Metal Workers Union.

D. Instrument calibration: Calibrate all instruments required for air and water balancing within a period of six months prior to their use on this project, per NEBB or AABC standards and the instrument manufacturers.

E. Tests shall be conducted in presence of the Architect-Engineer and/or the Owner or their representatives. Notify the Architect-Engineer and Owner in writing five working days before the start of testing.

1.4 DEFINITIONS:

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to increase or reduce fan speeds or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.


P. CTI: Cooling Tower Institute.


R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.5 SUBMITTALS:

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the Testing, Adjusting, and Balancing Agent and this Project's Testing, Adjusting, and Balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Contract Documents Examination Report: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

D. Certified Testing, Adjusting, and Balancing Reports: Submit 8 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.6 QUALITY ASSURANCE:

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

C. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Engineer.

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.7 COORDINATION:

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings, utilized for supply or return air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.
R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION:

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES:

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE Applications Handbook Chapter 34, AABC or NEBB national standards and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES:

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.
I. Check for airflow blockages.
J. Check condensate drains for proper connections and functioning.
K. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES:

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multi-zone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflow within the maximum allowable rpm listed by the fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each air-handling unit component.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. The Contractor shall make recommended corrective changes to align design and actual conditions.
   5. Adjust fan speed higher or lower than design, as necessary to attain design flow and pressure values. The Contractor shall make required replacements or adjustments to pulleys and belts to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower. The Contractor shall replace any equipment that does not perform as stated in the submitted product literature.

C. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to design airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in sub-mains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Re-measure each sub-main and branch duct, after all have been adjusted. Continue to adjust sub-mains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
   1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS:

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check flow-control valves for specified sequence of operation and set at design flow.
   3. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
   4. Set system controls so automatic valves are wide open to heat exchangers.
   5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES:

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.
3.8 MOTORS:

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.9 CONDENSING UNITS:

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.10 TEMPERATURE TESTING:

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION:

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.
J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES:

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
   2. Air Outlets and Inlets: 0 to minus 10 percent.
   3. Heating-Water Flow Rate: 0 to minus 10 percent.
   4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.13 REPORTING:

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT:

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems. All data may not apply to all project devices; provide data as applicable to the piece of equipment being tested.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   3. Project name.
   4. Project location.
5. COTR's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in mm, and bore.
   i. Sheave dimensions, center-to-center and amount of adjustments in mm.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data: Include the following:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in mm, and bore.
   f. Sheave dimensions, center-to-center and amount of adjustments in mm.
3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in L/s.
   b. Total system static pressure in Pa.
   c. Fan rpm.
   d. Discharge static pressure in Pa.
   e. Filter static-pressure differential in Pa.
   g. Cooling coil static-pressure differential in Pa.
   h. Heating coil static-pressure differential in Pa.
   i. Outside airflow in L/s.
   j. Return airflow in L/s.
   k. Outside-air damper position.
   l. Return-air damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following as applicable to the installed equipment:

   1. Coil Data: Include the following:
      a. System identification.
      b. Location.
      c. Coil type.
      d. Number of rows.
      e. Fin spacing in mm o.c.
      f. Make and model number.
      g. Face area in sq. m.
      h. Tube size in DN.
      i. Tube and fin materials.
      j. Circuiting arrangement.

   2. Test Data: Include design and actual values for the following:
      a. Airflow rate in L/s.
      b. Average face velocity in m/s.
      c. Air pressure drop in Pa.
      d. Outside-air, wet- and dry-bulb temperatures in deg C.
      e. Return-air, wet- and dry-bulb temperatures in deg C.
      f. Entering-air, wet- and dry-bulb temperatures in deg C.
      g. Leaving-air, wet- and dry-bulb temperatures in deg C.
      h. Water flow rate in L/s.
      i. Water pressure differential in kPa.
      j. Entering-water temperature in deg C.
      k. Leaving-water temperature in deg C.
      l. Refrigerant expansion valve and refrigerant types.
      m. Refrigerant suction pressure in kPa.
      n. Refrigerant suction temperature in deg C.
      o. Inlet steam pressure in kPa.

H. Gas-Fired Heat Apparatus Test Reports: In addition to the manufacturer's factory startup equipment reports, include the following:

   1. Unit Data: Include the following:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Fuel type in input data.
      g. Output capacity in kW.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in mm, and bore.
n. Sheave dimensions, center-to-center and amount of adjustments in mm.

2. Test Data: Include design and actual values for the following:
a. Total airflow rate in L/s.
b. Entering-air temperature in deg C.
c. Leaving-air temperature in deg C.
d. Air temperature differential in deg C.
e. Entering-air static pressure in Pa.
f. Leaving-air static pressure in Pa.
g. Air static-pressure differential in Pa.
h. Low-fire fuel input in kW.
i. High-fire fuel input in kW.
j. Manifold pressure in kPa.
k. High-temperature-limit setting in deg C.
l. Operating set point in kW.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in kW.

l. Electric-Coil Test Reports: For electric coils installed in air-handling units, include the following, where applicable:

1. Unit Data: Include the following:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in kW.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in L/s.
i. Face area in sq. m.
j. Minimum face velocity in m/s.

2. Test Data: Include design and actual values for the following:
a. Heat output in kW.
b. Airflow rate in L/s.
c. Air velocity in m/s.
d. Entering-air temperature in deg C.
e. Leaving-air temperature in deg C.
f. Voltage at each connection.
g. Amperage for each phase.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer’s serial number.
f. Arrangement and class.
g. Sheave make, size in mm, and bore.

h. Sheave dimensions, center-to-center and amount of adjustments in mm.

2. Motor Data: Include the following:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in mm, and bore.
   f. Sheave dimensions, center-to-center and amount of adjustments in mm.
   g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in L/s.
   b. Total system static pressure in Pa.
   c. Fan rpm.
   d. Discharge static pressure in Pa.
   e. Suction static pressure in Pa.

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:
   a. System and air-handling unit number.
   b. Location and zone.
   c. Traverse air temperature in deg C.
   d. Duct static pressure in Pa.
   e. Duct size in mm.
   f. Duct area (sq. m).
   g. Design airflow rate in L/s.
   h. Design velocity in m/s.
   i. Actual airflow rate in L/s.
   j. Actual average velocity in m/s.

L. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Test apparatus used.
   d. Area served.
   e. Air-terminal-device make.
   f. Air-terminal-device number from system diagram.
   g. Air-terminal-device type and model number.
   h. Air-terminal-device size.

2. Test Data: Include design and actual values for the following:
   a. Airflow rate in L/s.
   b. Air velocity in m/s.
   c. Preliminary airflow rate as needed in L/s.
   d. Preliminary velocity as needed in m/s.
   e. Final airflow rate in L/s.
   f. Final velocity in m/s.
   g. Space temperature in deg C.
M. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data: Include design and actual values for the following:
   a. Airflow rate in L/s.
   b. Entering-water temperature in deg C.
   c. Leaving-water temperature in deg C.
   d. Water pressure drop in kPa.
   e. Entering-air temperature in deg C.
   f. Leaving-air temperature in deg C.

N. Packaged Chiller Reports: For each chiller, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Make and model number.
   c. Manufacturer's serial number.
   d. Refrigerant type and capacity in L.
   e. Starter type and size.
   f. Starter thermal protection size.

2. Condenser Test Data: Include design and actual values for the following:
   a. Refrigerant pressure in kPa.
   b. Refrigerant temperature in deg C.
   c. Entering-water temperature in deg C.
   d. Leaving-water temperature in deg C.
   e. Entering-water pressure in kPa.
   f. Water pressure differential in kPa.

3. Evaporator Test Reports: Include design and actual values for the following:
   a. Refrigerant pressure in kPa.
   b. Refrigerant temperature in deg C.
   c. Entering-water temperature in deg C.
   d. Leaving-water temperature in deg C.
   e. Entering-water pressure in kPa.
   f. Water pressure differential in kPa.

4. Compressor Test Data: Include design and actual values for the following:
   a. Make and model number.
   b. Manufacturer's serial number.
   c. Suction pressure in kPa.
   d. Suction temperature in deg C.
   e. Discharge pressure in kPa.
   f. Discharge temperature in deg C.
   g. Oil pressure in kPa.
   h. Oil temperature in deg C.
   i. Voltage at each connection.
   j. Amperage for each phase.
   k. The kW input.
   l. Crankcase heater kW.
   m. Chilled water control set point in deg C.
5. Refrigerant Test Data: Include design and actual values for the following as applicable for the equipment installed:
   a. Oil level.
   b. Refrigerant level.
   c. Relief valve setting in kPa.
   d. Unloader set points in kPa.
   e. Percentage of cylinders unloaded.
   f. Bearing temperatures in deg C.
   g. Vane position.
   h. Low-temperature-cutoff set point in deg C.

O. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Manufacturer's compressor serial numbers.
   e. Compressor make.
   f. Compressor model and serial numbers.
   g. Refrigerant weight in kg.
   h. Low ambient temperature cutoff in deg C.

2. Test Data: Include design and actual values for the following as applicable to the equipment installed:
   a. Inlet-duct static pressure in Pa.
   b. Outlet-duct static pressure in Pa.
   c. Entering-air, dry-bulb temperature in deg C.
   d. Leaving-air, dry-bulb temperature in deg C.
   e. Condenser entering-water temperature in deg C.
   f. Condenser leaving-water temperature in deg C.
   g. Condenser water temperature differential in deg C.
   h. Condenser entering-water pressure in kPa.
   i. Condenser leaving-water pressure in kPa.
   j. Condenser water pressure differential in kPa.
   k. Control settings.
   l. Unloader set points.
   m. Low-pressure-cutout set point in kPa.
   n. High-pressure-cutout set point in kPa.
   o. Suction pressure in kPa.
   p. Suction temperature in deg C.
   q. Condenser refrigerant pressure in kPa.
   r. Condenser refrigerant temperature in deg C.
   s. Oil pressure in kPa.
   t. Oil temperature in deg C.
   u. Voltage at each connection.
   v. Amperage for each phase.
   w. The kW input.
   x. Crankcase heater kW.
   y. Number of fans.
   z. Condenser fan rpm.
   aa. Condenser fan airflow rate in L/s.
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

P. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:

1. Unit Data: Include the following, as applicable:
   a. Unit identification.
   b. Make and type.
   c. Model and serial numbers.
   d. Nominal cooling capacity in kW.
   e. Refrigerant type and weight in kg.
   f. Water-treatment chemical feeder and chemical.
   g. Number and type of fans.
   h. Fan motor make, frame size, rpm, and horsepower.
   i. Fan motor voltage at each connection.
   j. Sheave make, size in mm, and bore.
   k. Sheave dimensions, center-to-center and amount of adjustments in mm.
   l. Number of belts, make, and size.

Q. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.
   e. Model and serial numbers.
   f. Ratings.

2. Steam Test Data: Include design and actual values for the following:
   a. Inlet pressure in kPa.
   b. Condensate flow rate in kW.

3. Primary Water Test Data: Include design and actual values for the following:
   a. Entering-water temperature in deg C.
   b. Leaving-water temperature in deg C.
   c. Entering-water pressure in kPa.
   d. Water pressure differential in kPa.
   e. Water flow rate in L/s.

4. Secondary Water Test Data: Include design and actual values for the following:
   a. Entering-water temperature in deg C.
   b. Leaving-water temperature in deg C.
   c. Entering-water pressure in kPa.
   d. Water pressure differential in kPa.
   e. Water flow rate in L/s.

R. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
2. Test Data: Include design and actual values for the following:
   a. Static head in kPa.
   b. Pump shutoff pressure in kPa.
   c. Actual impeller size in mm.
   d. Full-open flow rate in L/s.
   e. Full-open pressure in kPa.
   f. Final discharge pressure in kPa.
   g. Final suction pressure in kPa.
   h. Final total pressure in kPa.
   i. Final water flow rate in L/s.
   j. Voltage at each connection.
   k. Amperage for each phase.

S. Boiler Test Reports: For boilers, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.
   e. Model and serial numbers.
   f. Fuel type and input in kW.
   g. Number of passes.
   h. Ignition type.
   i. Burner-control types.
   j. Voltage at each connection.
   k. Amperage for each phase.

2. Test Data: Include design and actual values for the following:
   a. Operating pressure in kPa.
   b. Operating temperature in deg C.
   c. Entering-water temperature in deg C.
   d. Leaving-steam temperature in deg C.
   e. Number of safety valves and sizes in DN.
   f. Safety valve settings in kPa.
   g. High-limit setting in kPa.
   h. Operating-control setting.
   i. High-fire set point.
   j. Low-fire set point.
   k. Voltage at each connection.
   l. Amperage for each phase.
   m. Draft fan voltage at each connection.
   n. Draft fan amperage for each phase.
   o. Manifold pressure in kPa.
T. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.15 ADDITIONAL TESTS:

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION
SECTION 16010 - ELECTRICAL GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The "General Conditions" and "Special Conditions" of Contract as written and referred to hereinbefore are adopted and made part of Division 16.

1.2 DESCRIPTION OF WORK:

A. Provide equipment, labor, etc., required to install complete working electrical system as shown and specified.

B. Provide fixed electrical equipment, except where specifically noted otherwise.

C. Provide portable electrical equipment for complete system.

D. Provide equipment and/or wiring normally furnished or required for complete electrical systems but not specifically specified on the drawings or in specifications, as though specified by both.

E. All equipment and wiring shall be new.

F. Electrical work includes, but is not limited to:
   1. Arrange with local utility companies for services as shown or specified.
   2. Removal or relocation of electrical services located on or crossing through project property, above or below grade, obstructing construction of project or conflicting with completed project or any applicable code.
   3. Alterations and additions to existing electrical systems.
   4. Complete 600 volt Distribution System. Provide meters, switchboards, panelboards, circuit breakers, power outlets, convenience outlets, switches, and/or other equipment forming part of system.
   5. Connection of all appliances and equipment.
   6. Complete Primary Distribution System; provide meters, switchgear, fuses, cable and other equipment forming a complete system.
   7. Complete emergency lighting system, individual battery units.
   8. Complete fire alarm system.
   9. Complete empty raceway system(s) for auxiliary system(s) as shown.
   10. Complete empty raceway system(s) for auxiliary system(s) as shown.
   11. Complete system of outlets and raceways for master television antenna system.
   12. Complete conduit and wiring for voice/data system.
   13. Complete lightning protection system.
   15. Provide temporary facilities for construction power.

1.3 WORK NOT INCLUDED:

A. Furring for conduit and equipment.

B. Finish painting of conduit and equipment.

C. Installation of motors except where specifically noted.

D. Control wiring for mechanical systems, except where indicated to be provided by Electrical Contractor.
1.4 RELATED WORK SPECIFIED ELSEWHERE:

A. Classification of excavation: Architectural Division.
B. Painting: Painting Division.
C. Concrete Work: Concrete Division.

1.5 REQUIREMENTS OF REGULATORY AGENCIES:

A. Obtain and pay for all permits required for the work. Comply with all ordinances pertaining to work described herein.
B. Install work under this Division per drawings, specifications, latest edition of the National Electrical Code, Local Building Codes, and any special codes having jurisdiction over specific portions within complete installation. In event of conflict, install work per most stringent code requirements determined by Architect.
C. Arrange, pay fees for and complete work to pass required tests by agencies having authority over work. Deliver to Architect Certificates of Inspection and approval issued by authorities.

1.6 QUALIFICATIONS OF CONTRACTOR:

A. Has completed minimum two projects same size and scope in past five (5) years.
B. This qualification applies to Sub-Contractors.
C. Use workmen experienced in their respective trade. Submit qualifications of Superintendent for review.
D. Owner reserves right to reject bid of any Contractor failing to meet these qualifications.

1.7 GENERAL JOB REQUIREMENTS:

A. Drawings and Specifications:
   1. Electrical work is shown on "E" series drawings inclusive. Follow any supplementary drawings as though listed above.
   2. Drawings and specifications are complementary. Work called for by one is binding as if called for by both.
   3. Drawings show general run of circuits and approximate location of equipment. Right is reserved to change location of equipment and devices, and routing of conduits to a reasonable extent, without extra cost to Owner.
   4. Refer conflicts between drawings and specifications describing electrical work and work under other Divisions to Architect for remedial action.
   5. Use dimensions in figures in preference to scaled dimensions. Do not scale drawings for exact sizes or locations.
   6. Execution of Contract is evidence that Contractor has examined all drawings and specifications related to work, and is informed to extent and character of work. Later claims for labor and materials required due to difficulties encountered, which could have been foreseen had examination been made, will not be recognized.
   7. Charges for extra work not allowed unless work authorized by written order from Architect.
approving charge for work.

B. Visit to Site:

1. Visit site to survey existing conditions affecting work. Include necessary materials and labor to accomplish the electrical work, including relocation of existing services and utilities on building site in bid. No consideration given to future claims due to existing conditions.

C. Definitions:

1. Provide: Furnish, install and connect complete.
2. Wire: Furnish all necessary wiring and connect complete.
3. Install: Set in place and wire complete.
5. AWG: American Wire Gage.
8. OSHA: Occupation Safety and Health Administration.
9. UL: Underwriters Laboratories, Inc.
11. IEEE: Institute of Electrical and Electronic Engineers.

D. Workmanship, Guarantee and Approval:

1. Work under this Division shall be first class with emphasis on neatness and workmanship.
2. Install work using competent mechanics, under supervision of foreman, all duly certified by local authorities. Installation subject to Architect's constant observation, final approval, and acceptance. Architect may reject unsuitable work.
3. Furnish Architect written guarantee, stating that if workmanship and/or material executed under this Division is proven defective within one (1) year after final acceptance, such defects and other work damaged will be repaired and/or replaced.
4. In event that project is occupied or systems placed in operation in several phases at Owner's request, guarantee will begin on date each system or item of equipment is accepted by Owner.

E. Observations of Work and Demonstration of Operation:

1. At all observations of work, open panel covers, junction box covers, pull box covers, device covers, and other equipment with removable plates for check. Provide sufficient personnel to expedite cover removal and replacement.
2. Contractor to assist Architect in demonstration of operation of new systems to satisfaction of Owner. Contractor to have manufacturer available for demonstration of systems where requested by Owner.

F. Testing of Electrical Systems:

1. Test Completed work as follows:
   a. Perform test required by Architect to indicate compliance with specifications, drawings and applicable codes. Provide instruments, labor and materials for tests.
   b. Insulation - use 1000 VDC insulation tester (0-500 megohm full-scale), equal to "Megger" as manufactured by Biddle Company. Test conductors and busses of all systems, including feeders, main service busway, branches, motors, devices, equipment, etc. Test branches for one (1) minute; test feeders, bus ducts, busses, etc., for 15 minutes with readings at one minute intervals.
   c. Receptacles:
(1) Use Woodhead Ground Loop Impedance Tester. Test each receptacle. Record readings.

2. Ground Testing:
   a. Testing of Made Ground Electrodes:
      (1) Test Ground Systems Indicated.
      (2) Using a measuring device which generates minimum of 500 VDC, calibrated in ohms (maximum 200 ohm scale) J.C. Biddle "Vibrotester" or approved equivalent.
      (3) Provide test electrode in accordance with Measuring Device Manufacturer's instructions. Use ground rods as specified in Section "Grounding".
      (4) Follow instructions of measuring device manufacturer for proper results.
      (5) Test grounds only when earth is dry.
      (6) Record ambient temperature, date, time, approximate water table level (as obtained from local geologists); type of earth material.

3. High Potential "Hi Pot" Testing of Equipment:
   a. Test cable and equipment indicated on plans or in specifications. Use D.C. high potential tester, as manufactured by J.C. Biddle or approved equivalent. Test equipment used capable of producing minimum specified voltage plus 25% additional voltage.
   b. Cable:
      (1) Test per IP CEA No. S-68-516 (NEMA WC8-1976).
      (2) Underwriters Laboratories Standard 1072.
      (3) Use voltage level as recommended by manufacturer of cable except not less than:

      | Cable Rating | Test Voltage (New Cable) | Test Voltage (Old Cable) |
      |--------------|--------------------------|--------------------------|
      | 5 KV         | 35 KV                    | 25 KV                    |
      | 8.7 KV       | 40 KV                    | 30 KV                    |
      | 15 KV        | 55 KV                    | 40 KV                    |
      | 35 KV        | 100 KV                   | 75 KV                    |

4. Dry Type Transformers:
   a. Test in accordance with following standards as applicable:
      (1) IEEE Standard 259
      (2) IEEE Standard 262-1973
      (3) ANSI C57.12.90.1973
      (4) NEMA TRI-1968
   b. Use voltage level as recommended by equipment manufacturer, except not less than:

      | Rating | Test Voltage |
      |--------|--------------|
      | 600 V  | 1.5 KV       |
      | 2.4 KV | 6.1 KV       |
      | 5 KV   | 12.75 KV     |
      | 7.6 KV | 19.3 KV      |
      | 15 KV  | 38.25 KV     |

5. Switchgear:
   a. Test switchgear in accordance with ANSI standard C37.20C-1974.
   b. Use following test voltages:

      | Equipment Rating | Test Voltage |
      |------------------|--------------|
      | 5 KV             | 20.2 KV      |
      | 15 KV            | 37.5 KV      |
6. Test interval - 15 minutes. Graph microampere leakage vs. time with values plotted each 30-60 seconds. Test to be discontinued if erratic results are observed. Test records include date, ambient temperature, relative humidity, and time of day.

7. Record all test results in loose leaf log for Owner. Test information required: Date of test; name of circuit or equipment; ambient temperature; weather conditions; final instrument readings; graph of readings for 15 minutes tests. Provide three copies of log.

8. Architect will observe tests. One week prior notice required.

G. Materials and Substitutions:

1. All material shall be new, with U.L. label where available. If U.L. label is not available, material shall be manufactured in accordance with applicable NEMA; IEEE and Federal Standards.

2. No material shall be substituted for specified, except by prior written approval of Architect. Specified catalog numbers are used for description of equipment and standard of quality only. Equivalent material given consideration only if adequate comparison data including samples are provided. Approval required prior to bid date. Bid substituted material only if approved in writing by Architect.

3. Submit to Architect within 30 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer on list does not constitute approval of specific material or equipment.

H. Shop and Erection Drawings:

1. Submit complete shop drawings for all material and equipment furnished under Division 16 of specifications, to Architect for review within thirty (30) days after award of contract. Shop drawings shall be submitted on timely basis to allow adequate lead time for review, re-submission if necessary, manufacture and delivery to allow access of material to project at correct time based on schedule established by Architect/Contractor. Include complete descriptive data with dimensions, operating data and weight for each item of equipment. Carefully examine shop drawings to assure compliance with drawings and specifications prior to submittal to Architect. Shop drawings and submittals shall bear the stamp of approval of the Electrical and General Contractor as evidence drawings have been checked by them. Drawing submitted without this stamp of approval will not be considered and will be returned for proper resubmission.

2. Drawings larger than 8-1/2” x 11”, submit 3 copies and 1 reproducible of each drawing. Architect will retain 2 copies and return 1 reproducible and 1 copy to Contractor. Contractor is responsible for copying reproducible for distribution.

3. 8-1/2” x 11” drawing in brochure: Submit 6 original copies for review. Architect will retain 2 copies and return 4 copies to Contractor.

4. Review of shop drawings does not relieve Contractor of responsibility for errors and omissions in shop drawings. Contractor is responsible for dimensions and sizes of equipment. Inform Architect in writing of equipment differing from that shown.

5. Prepare erection drawings when required by Architect. Investigate thoroughly all conditions affecting work and indicate on drawing. Architect will review erection drawings before work commences.

6. Provide for Owner one (1) set of final shop and erection drawings, except provide 1 set of 1.5 mil Mylar sepias of shop drawings larger than 8-1/2” x 11” size.

7. Coordination shop drawings will be required for the following areas, drawn to a scale of not smaller than 1/4” - 1'-0”:
   a. Electrical equipment rooms and areas.
   b. Electrical and mechanical equipment areas.
   c. Elevator penthouse.
   d. Start drawings as HVAC shop drawings indicating all ductwork piping, equipment and locations of mechanical room floor drains, and electrical connections. Indicate elevations of all ductwork and piping. Draw sections as required to clarify
congested situations.

e. Next, the Plumbing Section shall add all piping and plumbing equipment to the drawings.

f. Next, the Fire Protection Section shall add all sprinkler heads and fire protection piping.

g. Next, the Electrical Sections shall add all electrical fixtures, conduit and equipment.

h. Next, the drawings shall be submitted to the General Contractor for final coordination.

i. Finally, after the General Contractor has approved the drawings they shall be submitted to the Architect for approval.

I. Cooperation:

1. Carefully coordinate work with other contractors. Refer conflicts between trades to Architect.

2. Work to be installed as progress of project will allow. Schedule of work determined by General Contractor and/or Architect.

J. Maintenance and Operating Instructions for Equipment:

1. Submit to Architect one (1) set of data prepared by manufacturer for each item of electrical equipment completely describing equipment. Data to include parts lists, description of operation, shop drawings, wiring diagrams, maintenance procedures and other literature required for maintenance of equipment. Bind in booklet form for presentation.

K. Record Drawings:

1. Contractor shall maintain at the site one (1) copy of the drawings in good order and marked to record all changes made during construction.

2. Contractor shall update all drawings to incorporate all changes and deliver one (1) set of reproducible Mylar plans and one (1) electronic copy of the project in the latest “AutoCAD” version to the Owner upon completion of the work.

L. Items for Owner:

1. Provide following items for Owner at time of substantial completion:

   a. Certificates of inspection and approval from authorities having jurisdiction.
   b. Written guarantees.
   c. “Record” blue line prints.
   d. Final approved shop drawings one (1) set.
   e. Spare fuses (furnish receipt).
   f. Maintenance data one (1) set.
   g. Affidavit of Owner Instruction (1 copy).

M. Marking:

1. Identify each starter, (including starters furnished under Mechanical Section), panelboard, cabinet, control device, breaker, disconnect and safety switch with 1/4” high black letters cut in a white laminated phenolic strip. Use red letters for all equipment connected to emergency system. Attach to enclosure with two (2) metal screws.

2. Identify receptacle outlets in critical care areas with nameplates indicating circuit number and panel designation. Critical care areas include: Operating Rooms, Delivery Rooms, Intensive Care Units, Special Procedures Rooms, Emergency Trauma and Treatment Rooms. Plates shall be engraved with black fill. Outlets for emergency shall be similarly engraved in red.

3. Nameplates required for other items in this Division similar to those described above.
N. Protection and Storage:

1. Provide warning lights, bracing, shoring, rails, guards and covers necessary to prevent damage or injury.
2. Do not leave exposed or unprotected, electrical items carrying current. Protect personnel from exposure to contact with electricity.
3. Protect work and materials from damage by weather, entrance of water or dirt. Cap conduit during installation.
4. Avoid damage to materials and equipment in place. Repair, or remove and replace damaged work and materials.
5. Exercise particular care when working around telephone (electronic) equipment to prevent entrance of dust, moisture and debris into the equipment. Provide dust barriers and partitions as required.
6. Deliver equipment and materials to job site in original, unopened, labeled container. Store to prevent damage and injury. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloring. Store materials affected by condensation in warm dry areas. Provide heaters. Storage space on site and in building designated by Owner/Architect.
7. Install equipment per manufacturer's recommendations. Conflicts between contract documents and these recommendations, deferred to Architect.

O. Excavation and Backfill:

1. Excavate for work in this Division.
2. Avoid existing facilities in excavating. Contractor is responsible for repair and replacement of damaged facilities in executing work.
3. Backfill in twelve inch (12") lifts, wetted down and tamped. Compaction minimum 95% of adjacent earth.
4. Repairing to be comparable to work cut including new asphalt paving, concrete paving, sod, replanting shrubbery, etc. Architect will observe repair work, and reject unsuitable work.

P. Cutting and Repairing:

1. Cut and repair walls, floors, roof, etc., required to install work. Where work cut is finished, employ original installer of finish to repair finish. Do not cut structural members.

Q. Anchors:

1. Provide anchors for all equipment, raceways, hangers, etc. to safely support weight of item involved. Anchors to consist of expansion type devices similar to "Redhead" or lead expansion anchors. Plastic anchors are not acceptable.

R. Cleaning and Painting:

1. Clean equipment furnished in this Division after completion of work.
2. Touch-up or re-paint damaged painted finishes.
3. Remove debris, packing cartons, scrap, etc., from site.

S. Control Wiring:

1. Control Wiring including low voltage and line voltage interlock wiring will be furnished and installed under another Division, except where specifically shown otherwise. Carefully coordinate power and control wiring interface.

T. "Contingency Items":

1. Provide in electrical pricing the following components to consist of labor and materials for complete installation:
   a. 1 15 amp duplex receptacle and wall plate and 20 feet of 2#12 and 1#12(G)-1/2"C connected to circuit for power.
   b. 1 20 amp three phase breaker furnished and installed in panel.
   c. 2 Exit lights furnished and installed with box and 20 feet of conduit and wiring.
   d. 2 Two-head battery packs furnished and installed with mounting and 20 feet of conduit and wiring.
   e. Furnish and installed with all necessary programming to be an integral part of Fire Alarm system and 30 feet of circuit wiring in conduit connected to Fire Alarm wiring.

   (1) _____ Manual Pull Stations
   (2) _____ Ceiling Mount Smoke Detectors
   (3) _____ Duct Detectors
   (4) _____ Audio/Visual Notification Devices

2. Unused components will be turned over to Owner for their attic stock.

U. Code Compliance:

1. Entire electrical installation shall comply with all aspects of code including local interpretations. This includes but is not limited to:
   a. Installation adjustment to meet all code clearances between electrical such as ductwork, other HVAC, plumbing, fire protection, and structural systems.
   b. Locations for items such as fire alarm appliances, exit lights, egress lighting, disconnect switches, etc.

2. No additional compensation will be allowed for code compliance. Notify engineer of difficulty encountered for assistance.

END OF SECTION
SECTION 16011 - WORK IN EXISTING FACILITY

PART 1 - GENERAL

1.1 DOCUMENTATION OF EXISTING CONDITIONS:

A. Before new work begins, the Contractor shall determine and document in writing to the Architect the condition of existing electrical work and auxiliary systems remain in service. After new work begins, existing electrical work or systems found to be inoperative or defective and documented shall be repaired or replaced by Contractor at no addition cost to the Owner.

1.2 DEMOLITION OF EXISTING ELECTRICAL SYSTEMS:

A. Demolish existing electrical work, including auxiliary systems, in areas of existing building shown reworked. Coordinate removal of electrical systems with General Contractor and Owner.

B. In reworked areas, remove all electrical equipment; i.e.: Light fixtures, panelboards, switches, receptacles, auxiliary system devices, telephone outlets, etc; unless otherwise noted. Remove existing branch circuits (conduit, wire, outlet boxes) serving equipment to be removed. Abandon circuits concealed in concrete. Remove conductors from abandoned conduits. Leave existing branch circuits and feeders which run through reworked areas and serve existing equipment to remain in service, continuous and uninterrupted. Repair, reterminate, re-support, etc., any damaged circuits.

C. Abandon outlets in existing masonry walls: Remove plaster frames, fill outlet box with grout and patch finish to match existing wall. Cut off conduits at wall where stubbed-out in furred ceiling space.

D. Cut off conduits concealed in slab two inches below top of base floor slab and patch slab or floor to match existing.

1.3 CUTTING AND REPAIRING:

A. General Contractor shall do all cutting and repairing of walls, floors, roof, etc., required for installation of work installed in this Division but shall backcharge the Electrical Contractor for this work. Advise General Contractor of amount and nature of cutting and repairing necessary to install work prior to bid date.

B. Do not pierce exterior walls below grade with hanger bolts. Do not cut building structural members except as approved by Architect. Architect must approve cutting methods.

C. Repair work comparable with work cut. New finishes shall match adjacent finishes. Architect will approve repaired work and may reject unsuitable work.

1.4 CONTINUITY OF SERVICE:

A. Provide continuous, uninterrupted electrical service to existing outlets, apparatus, and equipment in existing building. Provide temporary wiring installed in safe, approved manner to equipment and outlets as required. Where service interruptions are required, obtain approval for interruption in writing from Owner 10 days prior to interruption. Include schedule of work to be performed and time required to accomplish work in request for interruption. Work during service interruptions may occur after normal working hours. Include premium (overtime) time labor in bid.

1.5 WORK IN RESTRICTED AREAS:

A. Work in areas normally restricted to public such as Operating Rooms, Intensive Care Units, etc., will be done at the convenience of the Owner. Most work will occur after normal working hours.
Include premium (overtime) labor in bid. Coordinate access areas with Owner and Architect prior to scheduling work.

1.6 SALVAGE:

A. Electrical equipment, wiring, etc., removed and not required to be part of new electrical installation is classed as salvage.

B. Salvageable equipment remains property of Owner. Store at site and/or within building as directed by Owner.

END OF SECTION
SECTION 16012 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION OF SUBMITTAL CATEGORIES:

A. Submittals required are defined below and specified in each section. Refer to Section 01300 get from Architect.

B. Shop Drawings include fabrication, layout, wiring diagrams, erection, setting, coordination, similar drawings and diagrams and performance data.

C. Samples are units of work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed.

D. Manufacturer's Data is standard printed product information concerning the standard portions of the manufacturer's products.

E. Certifications are written statements, executed specifically for the project application by an authorized officer of the contracting firm, manufacturer or other firm as designated, certifying to compliance with the specified requirements.

F. Test Reports are specific reports prepared by independent testing laboratories, showing the results of specified testing. Industry Standards are printed copies of the current standards in the industry.

G. Manufacturer's Product Warranties are manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed by the manufacturer if the product fails under certain conditions and time limits.

H. Operating Instructions are the written instructions by the manufacturer, fabricator or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down.

I. Maintenance Manuals are the compiled information provided for the Owner's maintenance of each system of operating equipment. Maintenance Materials are extra stock of parts or materials for the Owner's initial use in maintaining the equipment and systems in operation.

J. Guarantees are signed commitments to the Owner that certain acts of restitution will be performed if certain portions of work fail within certain conditions and time limits.

K. Product Data includes manufacturer's data pertaining to the products, materials and equipment of the work.

1.2 SUBMITTAL FORM AND PROCEDURES:

A. Submittals shall be made within 30 days of contract signing for projects of 12 months construction time or less. Make within 60 days for longer than 12 months construction time.

B. Submit shop drawings for all material and equipment furnished under Division 16 to Architect. Refer to Section 01300 get from Architect for submittal procedures.

C. Multiple System Items: Where a required submittal relates to a operational item of equipment used in more than one system, increase the number of copies as necessary to complete maintenance manuals for each system.

D. Response to Submittals: Submittals will be returned with indication that documents comply with specifications or that documents do not comply and what action must be taken to be in
compliance.

E. Coordinate electrical submittals through Contractor to Architect and assist Contractor in preparation of submittal.

F. Submittals shall bear the stamp and signature of electrical and general contractor. Failure to place same on drawings require resubmittal before review.

1.3 SPECIFIC SUBMITTAL REQUIREMENTS:

A. Shop Drawings:
   1. To accurate scale except where diagrammatic representations are specifically indicated.
   2. To show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment.
   3. To show conduit and conductor connections and other service connections.
   4. To show interfaces with other work including structural support.
   5. To include complete descriptive data, with dimensions, operating data and weight.
   6. To indicate deviation from the contract documents.
   7. To explain deviations.
   8. To show how deviations coordinate with portions of the work, currently or previously submitted.

B. Review of shop drawings shall not relieve Contractor of responsibility for errors or omissions in shop drawings. Any equipment which will not fit into space shown on drawings shall be called to the attention of the Architect in writing.

C. Samples: Architect's review of sample submittals:
   1. Limited to general type, pattern and finish.
   2. Not to include testing and inspection of the submitted samples.
   3. Compliance with specified requirements is exclusive responsibility of the Contractor.

D. Manufacturer's Data:
   1. Where pre-printed data covers more than one distinct item, mark copy to indicate which item is to be provided.
   2. Delete portions of data not applicable.
   3. Mark data showing portion of operating range required for project application.
   4. Elaboration of standard data describing a non-standard product processed as a shop drawing.

E. For each product include:
   1. Manufacturer's production specifications.
   2. Installation or fabrication instructions.
   3. Source of supply.
   4. Sizes, weights, speeds and operating capacities.
   5. Conduit and wire connection sizes and locations.
   6. Statements of compliance with required standard and governing regulations.
   7. Performance data, where applicable.
   8. Other information needed to confirm compliance. Manufacturer's recommended parts list.

F. Certifications: Submit with notarized execution.

G. Test Reports: Submit notarized test reports signed and dated by firm performing test.

H. Manufacturer's Product Warranties: Where published warranty includes deviation from required
warranty, product is disqualified from use on project, unless manufacturer issues a specific project warranty.

I. Operating Instructions submittal required:
   1. Manufacturer’s operating instructions for each item of electrical equipment.
   2. Supplement with additional project application instructions where necessary.
   3. Specific operating instructions for each electrical system which involves multiple items of equipment. Instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operations.
   4. Typewritten in completely explained and easily understood English language.

J. Maintenance Manual Requirements:
   1. Emergency instructions including addresses and telephone numbers for service sources.
   2. Regular system maintenance procedures.
   3. Proper use of tools and accessories.
   4. Wiring and control diagram for each system.
   5. Manufacturer’s data for each operational item in each system.
   6. Manufacturer’s product warranties and guarantees relating to the system and equipment items in the system.
   7. Shop drawings relating to the system.
   8. Bind each maintenance manual in one or more vinyl-covered, 2”, 3-ring binders, plus pocket-folders for folded drawings. Index with thumb tab for sections. Mark the back spine and front cover of each binder with system identification and volume number.

K. Maintenance Materials: Deliver to Owner in fully identified containers or packages suitable for storage.

L. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal. Submit draft of each guarantee prior to execution.

END OF SECTION
SECTION 16013 - TEMPORARY ELECTRICAL FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish temporary electrical facilities to provide lighting and power for construction.

B. Work or cost not included in the Section:

1. Electrical energy cost during construction period.
2. Circuits for equipment requiring either heavy current or special voltages. (Negotiate directly between this Division and other Divisions requesting special services).
3. Circuits for exterior lighting.
4. Relocation of temporary wiring after installation.
5. Wiring not specified below.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General: Provide new or used materials and equipment suitable for intended use. Ensure safe, adequate performance of facilities in accordance with governing regulations. Used equipment shall be in good working order.

PART 3 - EXECUTION

3.1 INSTALLATION AND OPERATION:

A. Except for self-contained facilities, connect and terminate temporary electrical facilities at locations required for proper distribution.

B. Do not subject electrical facilities on either temporary work or temporary use of permanent work to excess demand or overload.

3.2 SERVICE CONNECTION:

A. Obtain temporary service from Power Company.

B. Include charges of Utility Company for temporary service connection. Pay all "Connect and disconnect charges of Utility Company".

C. Provide underground primary service to temporary transformer station described below and shown on drawings. Install primary cable in an existing spare underground duct to station location. Furnish required duct connections at each end of run.

D. Provide primary riser pole shown on drawing complete with hardware.

E. Underground primary cable for temporary service rated 15 KV, with minimum 100% insulation level. Use individual copper or aluminum conductors with concentric neutral conductor (minimum 1/3 capacity neutral). Ground neutral conductor at all terminations. Terminate conductors with weatherproof 15KV stress cones. Lash cable in manholes to racks. Splices water-tight with shields, neutrals, etc., properly terminated.

3.3 TRANSFORMER STATION:

A. Provide temporary transformer station to serve construction power loads all inclusive. At Contractor's option, the station may be either:
1. Medium Voltage to 120/240 volts, 3 phase, delta; 120/208 volts, 3 phase, wye; or 277/480 volts, 3 phase, wye.

B. Coordinate temporary service requirements for project and provide proper voltage, phase, etc., at proper locations.

C. Special equipment or services will not be a basis for change order.

D. Transformers:
   1. OISC with rating as necessary to provide the demand load for any 15 minute period, not exceeding 175% of full load rating of transformer(s).
   2. Sized for maximum 10% voltage drop on starting large motors.
   3. Single or three phase.
   4. Mounted in transclosure or confined by 10 foot high fence.
   5. Lock access to live parts and post "Danger High Voltage" signs.
   6. Provide fused cutouts and lightning arrestors with ratings for protection of transformers.
   7. Provide ground grid with a minimum of four (4) - 3/4" diameter x 10' ground rods connected with #4/0 bare copper. Connect to transformer cases and primary and secondary neutrals and cable shields.
   8. Work in accordance with NEC, National Electrical Code, and OSHA.

3.4 GROUNDING:

A. Power service and distribution system properly grounded in accordance with NEC requirements.

B. Ground system neutral.

C. Provide feeders and branch circuits not installed in metallic raceway with ground wire per NEC.

3.5 POWER SYSTEM AND DISTRIBUTION:

A. Provide required distribution and capacity of system. Overcurrent protection, fusible and/or circuit breakers sized per NEC.

B. 120/240 volts, single phase system; use 3-wire 120/240 volt feeders and branch circuits.

C. 120/208 volt, 3 phase, 4-wire system; use 120/208 volt balanced single phase 3-wire distribution or 120/208 volts, 3 phase, 4-wire distribution.

D. 480 volt, 3 phase, 3-wire distribution system; use balanced 2-wire single phase or 3-wire, 3 phase feeders for step-down to 120/240 volt or 120/208 volt utilization.

E. 277/480 volt distribution system; use balanced 2-wire single phase or 3 and 4-wire, 3 phase feeders for step-down to 120/240 volt or 120/208 volt utilization.

F. Step-down transformers inside building: dry-type construction; protect from weather and construction damage.

G. Use No. 12 wire for branch circuits less than 100 feet to last outlet, and No. 10 wire for circuits beyond 100 feet.

H. Balance loads connected to 3 phase services within reasonable limits.
3.6 PLUG-IN RECEPTACLES:
   A. 20A, duplex, NEMA grounded type or as required for special equipment.
   B. Branch circuits feeding receptacles: 20A or as required for special equipment.
   C. Provide receptacles to be reached by 50 foot extension cord. Protect receptacle circuits by dynamic type ground-fault circuit-interrupters which automatically disconnect circuit when leakage current of 4-6MA is detected.

3.7 LIGHT SOCKETS:
   A. Rubber pigtail type, compatible with lamps, with guards.
   B. Lamps; 150 watt to 300 watt sizes as directed.
   C. For estimating purposes, figure total number of light sockets as follows:
      1. One for every 750 square feet of interior rooms.
      2. One for every 1500 square feet of exterior rooms with windows.
      3. Exterior rooms which contain windows with room depth less than 10 feet from exterior wall, require no socket. Exterior rooms more than 10 feet deep calculated by excluding exterior 10-foot bay.
      4. Provide minimum one light in every interior room regardless of area.
      5. Lighting Levels:
         a. For constriction install lighting to levels required by OSHA, industry standards and general contractor.

3.8 LAMPS AND REPLACEMENTS:
   A. Provide lamps.
   B. Replace burned out lamps.

3.9 INSTALLATION OF CIRCUITS:
   A. Install required lighting and receptacle circuits along a route least objectionable to construction work as determined by Contractor.

3.10 PERMANENT WIRING SYSTEM:
   A. Do not use permanent wiring for construction without specific approval of Architect. Before using permanent wiring for temporary service, submit a list of uses to Architect. Architect may refuse use of permanent equipment for temporary service. Use of permanent equipment prior to Substantial Completion shall not affect warranty period.

3.11 REMOVAL AND RESTORATION:
   A. After use, remove temporary facilities and temporary provisions of permanent electrical work. Repair or replace work damaged by temporary electrical facilities. Clean and restore permanent electrical system used to provide temporary services to condition of new and unused work.
   B. Electrical work installed as temporary facilities, upon removal, remains property of Installer.
   C. Replace lamps of permanent light fixtures used for temporary lighting which have burned out or are noticeable dim.
   D. Where temporary use of lamps exceeds one month, replace lamps.
E. At Substantial Completion, clean permanent electrical work used as temporary facilities. Remove debris accumulated in electrical spaces.

END OF SECTION
SECTION 16014 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Systems and equipment requiring identification are shown on the drawings, and extent of identification is specified herein and in individual sections of work.

B. Types of electrical identification include:

1. Exposed conduit color marking.
2. Buried cable and conduit warnings.
3. Cable/conductor identification.
4. Operational instructions and warnings.
5. Danger signs.

1.2 SUBMITTALS:

A. Manufacturer's Data:

1. Product specifications and installation instructions for each material and device.

B. Samples:

1. Provide for each color, lettering style and other graphic representation.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIAL:

A. Color-Coded Conduit Markers:

1. Color code all conduit with 3/4 inch wide band of vinyl plastic electrical tape, 3M Company “Scotch 35”, applied two (2) full turns around conduit, 6” from all conduit terminations into switchboards, panelboards, motor control centers, starters, cabinets, control panels, pullboxes, outlet boxes, etc., on each side of walls, floors or roof penetrated by conduit and where conduit enters wall to outlets below.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208 Volts - Normal</td>
<td>Black</td>
</tr>
<tr>
<td>277/480 Volts - Normal</td>
<td>Yellow</td>
</tr>
<tr>
<td>120/208 Volts - Emergency</td>
<td>Black and Red</td>
</tr>
<tr>
<td>277/480 Volts - Emergency</td>
<td>Yellow and Red</td>
</tr>
<tr>
<td>Intercom/Paging/Music/Telephone/Dictation</td>
<td>Brown</td>
</tr>
<tr>
<td>Computer/Word Processing/Monitoring/Security</td>
<td>Blue</td>
</tr>
<tr>
<td>Fire Alarm</td>
<td>Orange</td>
</tr>
</tbody>
</table>

B. Where authority does not allow tape use paint acceptable to authority.

C. Underground Plastic Line Marker:

1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, for direct-burial service; minimum 6" wide x 4 mils thick. Printing to indicate type service of cable.
D. Cable/Conductor Identification Bands:
   1. Manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers, wrap-around type; pre-numbered plastic coated, or write-on type with clear plastic self-adhesive cover flap, lettered to show circuit identification.

E. Self-Adhesive Plastic Signs:
   1. Manufacturer's standard, self-adhesive, pre-printed, flexible vinyl signs for operational instructions or warnings. Sizes suitable for application and visibility, with proper wording for application.
   2. Color: Orange with black lettering.

F. Danger Signs:
   1. Manufacturer's standard "DANGER" signs, baked enamel finish on 20 gage steel; standard red, black and white graphics; 14" x 10" unless 10" x 7" is largest which can be applied, or where larger size is needed for visibility use recognized explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

G. Engraved Signs (Nameplates)
   1. 1/8" thick melamine plastic laminate, complying with FS LP-387, sizes as indicated, engrave with standard letter style of sizes and wording indicated (1/4" letters minimum) white field, black letters for normal service; red field, white letters for essential service; yellow field, blue letters for D.C. service; orange field, white letters for UPS service. Punched for screws.
   2. Fasteners: Self-tapping stainless steel screws, except contact epoxy adhesive where screws cannot or should not penetrate substrate.

H. Lettering and Graphics:
   1. Coordinate names, abbreviations and other designations used with those shown or specified. Provide numbers, lettering, and wording as indicated or required for identification and operation/maintenance.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. General Installation Requirements:
   1. After completion of painting.
   2. Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:
   1. Where high voltage conduit is exposed, apply identification to conduit.

C. Underground Cable Identification:
   1. During back-filling of underground cable, install continuous marker, directly over buried line 6" to 8" below finished grade. Where multiple lines are buried in common trench not exceeding 24" width, install a single line marker.
   2. Install line marker for every buried ductbank.
D. Operational Identification and Warnings:

1. Provide operational signs for main switch.

E. Danger Signs:

1. Provide for 5 KV to 35 KV medium voltage switchgear, sectionalizer loop switches, etc., as shown and described herein.
2. Provide as required by codes.

F. Engraved Plastic Laminated Signs: Install on each major unit of electrical equipment in the building. Provide single line of text, 1/4" high lettering on 1" high sign (1-1/2" high where 2 lines required). Matching terminology and numbering of contract documents. Provide signs for each unit of the following categories (signs shall identify item fed, voltage where fed from):

1. Electrical cabinets and enclosures. Indicate voltage.
2. Access panel/doors to electrical facilities.
3. Major electrical switchgear (indicate voltage).
4. Electrical substations.
5. Safety switches and circuit breakers.
6. Transformers.
7. Feeders in pull and junction boxes and in all switchgear. Fasten with nylon ties.
8. All equipment furnished in this Division of the specifications.
9. Install signs where indicated or most visible. Secure with screws or epoxy adhesive. Secure to feeder cables with nylon ties.
10. Nameplate sign shall include system voltage and source of feed (where applicable).

G. Outlet pull, and junction boxes shall be identified with circuit number(s), and source panel or switchgear-switchboard indicated with legible text written with permanent black marker. Write text and box cover.

H. Branch circuit and feeder conductors shall be identified where they enter pullboxes, switchgear, switchboards, panelboards, transformers, and handholes. Feeder identification shall include source, conductor size, and phase identification.

I. Provide engraved device plates for wiring devices where indicated on drawings or related sections of the specifications.

1. Use black letters for devices on normal circuits; use red letters for essential circuits.

END OF SECTION
SECTION 16015 - EXCAVATING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. The extent of excavating and backfill work includes excavating and backfilling to install work specified herein.

B. Work requiring excavations and backfill include:
   1. Underground wiring.
   2. Independent foundations.
   3. Power poles.

1.2 JOB CONDITIONS:

A. Locate and protect existing utilities and other underground work to prevent damage or service interruption.

B. Protect property from damage which might result from excavating and backfilling.

C. Protect persons from injury at excavations, by barricades, warnings and illumination.

D. Coordinate work with weather conditions, to minimize damage and hazard.

E. Provide temporary enclosure and heat necessary to protect bottoms of excavations from freezing. Do not install work on frozen excavation.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:


PART 3 - EXECUTION

3.1 EXCAVATING:

A. Examine areas to be excavated, and conditions under which work is to be performed.

B. Excavate with vertical-sided excavations where possible. Where necessary, provide shoring, sheeting and cross-bracing. Remove sheeting and cross-bracing during backfilling where removal would not endanger the work. Where not removed, cut sheeting below grade to avoid interference with other work.

C. Excavate for conduit with 9"+ clearance each side of conduit.

D. Excavate for other electrical work to provide adequate working clearances.

E. For work supported on undisturbed soil, excavate to required depths. Hand-excavate bottom to accurate elevations. Support following work on undisturbed soil:
   1. Single conduits of 5" and less nominal size.
   3. Flat-bottomed multiple-duct conduit units.
F. Where sub-base material is indicated, excavate for depth indicated.

G. Excavate additional depth as directed to reach satisfactory soil-bearing. Backfill with sub-base material, compacted as directed.

H. Excavate within drip line of trees by hand. Protect root system from damage or dry out. Do not cut roots without Contracting officer or his designated representatives approval. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts with asphaltic tree paint.

I. No blasting is allowed unless approved in writing by Architect or his designated representative will approve methods for removing rock.

J. Store excavated material near excavation. Do not store under trees.

K. Retain excavated material meeting backfill requirements.

L. Remove excess excavated material from site.

3.2 ROCK EXCAVATION:

A. Rock excavation consists of removal and disposal of materials encountered that cannot be excavated with a 3/4 cubic yard capacity power shovel without drilling and blasting, or requiring use of special equipment, except such materials that are classified as earth excavation.

1. Typical of materials classified as rock are boulders 1/2 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementations aggregate deposits.
2. Intermittent drilling or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

B. Rock payment lines are limited to the following:

1. Two feet outside of concrete work for which forms are required except footings.
2. One foot outside of perimeter of footings.
3. In pipe trenches, 6" below invert elevation of pipe and 2 ft. wider than inside diameter of pipe, but not less than 3 ft. minimum trench width.
4. Neat outside dimensions of concrete work where no forms are required.
5. Under slabs on grade, 6" below bottom of concrete slab.

3.3 DEWATERING:

A. Maintain dry excavations. Protect from surface water. Pump water from excavations.

3.4 BACKFILLING:

A. Backfill with suitable material.

B. Condition backfill material for compacting by drying or adding water as required. Do not backfill with frozen materials.

C. Backfill carefully. Do not dislocate the work. Backfill excavations in 12" loose lifts to 95% density in on grade areas and 100% in paved areas.

D. Backfill to adjacent grades.

E. Where concrete occurs under pavement, backfill to level beneath existing concrete, dowel new layer of concrete into existing, thickness and type to match existing.
3.5 PERFORMANCE AND MAINTENANCE:

A. Where subsidence is measurable or observable at excavations during warranty period, remove surface and backfill material, compact, and replace surface treatment to match adjacent work.

3.6 EXISTING UTILITIES:

A. Before starting excavation, this Contractor is responsible for utilities showing evidence of being in the area of excavation, to have their respective personnel locate and stake underground utilities to avoid cutting any.

B. This Contractor is responsible for maintaining stakes indicating lines. Record location of staked lines on "Record" drawings.

C. Use hand excavation in areas where existing communication circuits occur.

D. Where existing utility circuits, piping, ducts, etc., are damaged, this Contractor shall be responsible to have damaged utility repaired to satisfaction of Architect. No repaired utility shall be covered until approved by Architect. The Contractor shall not repair communication circuits. Only the involved utility shall repair these circuits. Any charges for repair of these circuits by the utilities shall be paid by the Contractor directly to the utility involved and shall not be the basis for change order.

E. Existing utility lines shown on drawings are taken from all available drawings and subsurface information available. Exercise extreme care in excavation to avoid existing utilities. Where existing utilities are not as shown record locations and depths on "Record" drawings.

3.7 PLANTING AND RESODDING:

A. Where existing grass sod is cut, Contractor shall remove with care and store to prevent dying. Keep stored sod moist. After excavation and backfill, replant sod and fertilize, water, etc., to assure continued growth. If sod dies within one year of substantial completion of contract, replace sod with new sod to match existing. Where existing grass plot is not sodded, seed top of backfill with mixture Kentucky #1 Fescue grass seed and Rye grass seed to hold soil. Fertilize for proper growth.

B. Where excavation requires removal of small trees, shrubs, and plants, remove plants with ball of dirt adequate to cover roots and store with burlap bag around ball. Keep ball moist. After excavating and backfill, replant material in same location of removal. Replace any material which dies as a result from this excavation within guarantee period

C. Replace any ground cover (crushed stone, pine bark chips, pine straw, etc.) affected by this excavation.

END OF SECTION
SECTION 16030 - COORDINATION

PART 1 - GENERAL

1.1 DRAWINGS FOR MECHANICAL, PLUMBING, FIRE PROTECTION AND ELECTRICAL WORK
   A. Drawings contain diagrammatic layouts and indicate general arrangement of systems, piping conduit, etc.
   B. Prior to installation of material and equipment, review and coordinate work with Architectural and Structural Drawings and other Division work for exact space conditions; where not readily discernable request information from Architect before proceeding.
   C. Check Drawings of all other trades to verify extent of material and equipment to be installed in spaces available and consider layout alternatives so that all requirements can be accommodated.
   D. Maintain maximum headroom at all locations without finished ceilings.
   E. Maintain finished ceiling heights as indicated on Architectural reflected ceiling plans, and building sections and elevation drawings.
   F. Coordinate installations with other trades prior to proceeding to prevent conflict with work of other trades and cooperate in making reasonable modifications in layout as needed.
   G. Where conflicts occur with placement of mechanical and electrical materials as they relate to placement of other building materials, the Architect shall be consulted for assistance in coordination of the available space to accommodate all trades.
   H. Coordinate equipment installation to maintain manufacturer and code required working clearances.

1.2 PRIORITY OF CONSTRUCTION SPACE
   A. Following is the Order of Priority for Construction Space:
      1. First: Ductwork.
      3. Third: Other piping.

1.3 COORDINATION DRAWINGS
   A. The Contractor shall prepare a complete set of "Cronoflex Mylar" type background drawings at scale of minimum 1/4" equals 1'-0".
      1. The construction documents in their original, copies or electronic file form are the Architect's instrument of service and are protected under copyright laws. The reproduction of these documents for use as coordination drawings or shop drawings is prohibited without the Architect's written consent and authorization.
   B. Each specialty trade listed below shall prepare a coordination Mylar overlay indicating his work, with appropriate elevations and grid dimensions.
   C. Each specialty trade shall sign and date the coordination Drawing after the addition of his information.
   D. Fabrication shall not start until receipt of completed coordination drawings is acknowledged by
the Contractor in writing to the Architect.

E. Specialty Trades:

1. Ductwork
2. Fire protection piping
3. Other piping
4. Electrical
5. Plumbing piping to include but not limited to sanitary, vent, pressure storm, medical gas (if provided), compressed air, natural gas, etc.

F. Coordination Drawings required for all mechanical rooms, electrical rooms, equipment rooms, corridors, horizontal exits from duct shafts, cross-overs and any other areas where congestion of work may occur.

G. Coordination Schedule Drawing:

1. The mechanical and plumbing contractor shall furnish to electrical contractor for coordination a schedule drawing providing all the electrical characteristics of all mechanical and plumbing equipment requiring electrical connection. The information provided shall include:
   a. Unit Designation
   b. Voltage
   c. MCA
   d. MOCP/MFS
   e. FLA
   f. Disconnect Requirement
   g. Starter Requirement
   h. Alarm Wiring Requirements

2. The coordination schedule drawing, once received by the electrical contractor, shall be reviewed and all pertinent electrical accommodations indicated.
   a. Breaker size.
   b. Wire size / conduit size.
   c. Disconnect with fuse size.

3. Once the coordination schedule is completed forward to the engineers for review and approval.

H. Conflicts that arise due to the fact that the coordination schedule drawing was not completed shall be the sole responsibility of the contractors. All costs for correction or remedial work shall be done at the contractor’s expense. No added cost to the owner will be allowed.

END OF SECTION
SECTION 16110 - RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Installation of raceway systems for all work in Division 16 and required fittings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Metallic Raceways:

1. Republic
2. Wheatland
3. Allied
4. Clifton
5. Triangle
6. Walker
7. Western
8. AFC

B. Non-Metallic Raceways

1. Carlon
2. National Pipe & plastics
3. Can-Tex
4. Allied

C. Fittings

1. Thomas & Betts
2. Hubbell: RACO; Killark
3. Appleton
4. Midwest
5. EFCOR
6. OZ Gedney
7. Bridgeport
8. AFC

2.2 RACEWAYS

A. Rigid galvanized steel conduit to conform to ASA Standard C80.1 and U.L. Standard No. 6 for rigid metallic conduit, except hot dipped galvanized after threading.

1. Fittings, ells, couplings, etc., galvanized threaded type meeting above standards. Threadless fittings not allowed.
2. Terminate rigid conduit with two locknuts, one inside, one outside of the cabinet, junction or outlet and a bushing. Bushing - malleable iron with smooth bakelite ring molded into edge of bushing to prevent damage to cable, OZ Mfg. Co., type "B" or approved equal. Where grounding bushings are required, construction of bushing similar to above except a lug provided for grounding connection, OZ type "BLG" or approved equal.

B. Rigid intermediate grade conduit, IMC, to conform to UL Standard No.1242; hot dipped galvanized or approved equivalent.

1. All fittings, ells, couplings, etc., constructed to same standards as rigid steel conduit.
Fittings - threaded type with all threads engaged. Use "Uni-swivel" couplings in dry locations only.

2. Conduit terminations same as rigid steel conduit.

C. Flexible steel conduit, "Greenfield", continuous spirally wound and inter-locked, threadless, galvanized conforming to U.L. and CSA Standards for flexible steel conduit.

1. Connectors and fittings galvanized steel, threadless type with insulated throats, U.L. approved for grounding means.

D. Liquid tight flexible steel conduit constructed similar to flexible steel conduit above, except with polyvinyl chloride jacket.

1. Fitting Assembly - sealing type, with steel gland, nylon ring and ground cone inside locknut. All fittings with insulated throat, U.L. approved for grounding means.

E. Electrical metallic tubing, EMT, threadless, steel type conforming to ASA Standard C80.3 galvanized inside and out, and with additional corrosion resistant finish.

1. Fittings, connectors, couplings, etc., insulated throat galvanized steel screw indenter.

F. Plastic conduit, PVC, polyvinyl chloride compound, rated for direct burial, Schedule 40, except as noted otherwise.

1. Fittings same material as conduit and installed with watertight joint compound recommended by manufacturer.

G. Type EB - encased burial duct: Polyvinyl chloride compound conforming to NEMA Standard TC-6, UL listed and designed for encased burial use.

1. Fittings same material as conduit and installed with watertight joint compound recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install conduit as follows:

1. Use rigid steel or intermediate grade conduit for:
   a. Circuits run underground.
   b. Circuits run in concrete in contact with earth.
   c. Circuits in hazardous and wet locations.
   d. Circuits exposed to mechanical damage.
   e. All feeders (1-1/4" diameter and larger).
   f. All motor circuits.

2. Use electrical metallic tubing, EMT, for:
   a. Branch circuits (conduit 1" diameter and smaller) in dry locations.
   b. Telephone circuits.
   c. Auxiliary systems and controls (low voltage systems such as fire alarm nurse call sound systems, etc).
   d. Feeders run overhead in dry locations.

3. Use PVC conduit for:
   a. Circuits run underground where indicated.
   b. For branch circuits in concrete slab.
   c. Where specifically shown on drawings.
d. No PVC shall be exposed.

4. Use type EB conduit for exterior concrete encased application where shown.

B. Size conduit per NEC. Minimum size 1/2" diameter, but no more than 3#12 installed in 1/2" conduit.

C. Run conduit concealed where possible. Run concealed conduit above furred ceiling in an orderly manner. Multiple conduits grouped and run parallel.

D. In concrete slab: Install conduits in center of concrete slabs and tie to reinforcing steel with tie wires. Do not install conduit larger than 1" in concrete slabs unless approved by Architect. Install with minimum of 2" between parallel runs. Do not cross conduits in slab unless necessary, then only one conduit crossover in 12" space.

E. Exposed Conduit: Use only where specifically shown or approved. Run perpendicular to building walls and partitions and tight against structure. Conceal vertical portion of conduits where possible.

F. Paint underground metal conduit with 2 coats of asphaltum or bituminous. Make underground conduit fittings watertight using Teflon tape. Do not use split couplings and similar fittings underground and exposed to moisture. Run underground conduits minimum 24" below grade. Do not run conduit in slag fill.

G. Paint conduit fittings and threads exposed to moisture with Rustoleum silver paint after installation.

H. Furnish offsets required to meet field conditions. Make bends in conduit in accordance with the National Electrical Code, except make minimum radius of 6 times conduit diameter or 6" whichever is greater. Bend IMC conduit without deforming.

I. Where conduit crosses expansion joints, install expansion type fittings OZ type EX with bonding jumper or approved equal.

J. Make connections to equipment away from wall with conduit extensions exposed from ceiling to floor, anchored with floor flange and/or angle frame as required. Make connections to equipment with flexible conduit from tee conduit in conduit riser.

K. Vibrating equipment and equipment requiring adjustment, i.e.: motors, transformers, etc: make final connections with flexible conduit.

L. Isolate conduit connections to equipment on roof from roof penetration of conduit with short section of flexible conduit between roof penetration and equipment.

M. Use liquidtight flexible conduit where exposed to moisture, oil, etc.

N. Install conduit to avoid hot water pipes. Maintain 9" clearance of such pipes, unless closer crossings are unavoidable. Maintain minimum 1" clearance from covering of pipe crossed.

O. Support conduit per NEC. Support individual conduits with galvanized hangers and rods as follows:

- 1" diameter and smaller .......................................................... ¼" dia. rod
- 1-¼" to 3" diameter ................................................................. 3/8" dia. rod
- Larger than 3" diameter .......................................................... ½" dia. rod

P. Individual conduit hangers - Minnerallac, or approved equal. Support EMT near each joint. Support for multiple conduit runs consist of Uni-strut channel as required with 1/2" diameter galvanized bolts or rods anchored to structure. Provide "U" bolt clamps for each conduit on
hangers. Support vertical riser conduits with galvanized bolted clamps at each floor. Do not support conduit to ceiling support system.

Q. Terminate conduits entering sheet metal boxes with double locknuts and bushings. Terminate conduit exposed to moisture with watertight hubs.

R. Install appropriate seal-off where conduits exit hazardous areas, areas of temperature differential etc.

S. Where ground conductor installed in conduits 1-1/4" and larger provide grounding bushings, and bond full size ground wire to bushings and from bushing to box or cabinet. Bond with self-tapping screw and appropriate lug. Where ground wires are run in smaller conduits, bond to outlet and junction boxes with self-tapping screw lug. Provide other conduits with non-grounding bushings as described under another article. Provide all service entrance metallic raceways with grounding bushing and bond to ground bus; bond sized per N.E.C.

T. Conduit work in hazardous areas, or areas with large temperature differential: Use rigid steel or IMC conduit with sealing fittings, poured with hardening compound after conductors are pulled-in. Seals installed per NEC. Conduit seals Crouse-Hinds type EYS or approved equal.

U. PVC Conduit Installation:
   1. Above ground: Allow for expansion and contraction.
   3. Make elbows, bends, etc., with heated bender when factory bends are not available.
      a. When below slab, provide rigid elbows.
   4. Make cuts with hacksaw and deburr ends.
   5. Make joints as follows:
      a. Clean outside of conduit to depth of socket, and inside of socket with approved cleaner. Apply solvent cement to interior of socket and exterior of conduit. Insert conduit in socket and rotate 1/4 to 1/2 turn and allow to dry.
   6. Where non-metallic conduit is used for power wiring install insulated ground wire, sized per NEC unless shown larger.

V. Sleeves:
   1. Provide sleeves for raceways penetrating floor and structural members. Sleeves consist of Electrical Metallic Tubing set in forms. (Exception: Use Schedule 40 PVC for individual ground conductors).
   2. Size sleeves to allow 1/2" clearance around raceway extending from bottom of floor construction to 2" above floor, minimum sleeve size 2-1/2" diameter. After raceways are installed, seal space between the raceway and sleeve with non-hardening, fireproof, compound, CTC PR-855 sealant, T&B "Flame Safe" for 2 hour fire rating or approved equal.

END OF SECTION
SECTION 16120 - CONDUCTORS (Low Voltage, 600 Volts)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
A. Furnishing, installing and testing 600 volt conductors for lighting, power, and auxiliary systems.

PART 2 - PRODUCTS

2.1 CONDUCTORS:
A. 98% conductivity copper; #12 AWG minimum; #10 AWG and smaller solid, #8 and larger stranded.
B. Conductors #2 and larger, use high conductivity, flexible, high torque retention compact strand aluminum
C. Conductors furnished with NEC, 600 volt, insulation as follows:
   1. Dry locations:
      a. # 6 AWG and smaller: type THW, THWN or XHHW (do not intermix in circuits)
      b. # 4 AWG and larger: type RHH-RHW-USE, (cross linked polyethylene)
   2. Wet locations: type RHH-RHW-USE
D. Wiring for controls and auxiliary systems #14 AWG minimum with NEC type THWN insulation.
E. Luminaire Wire: Incandescent - Use type SF-2, #16 for luminaires up to 300 watts, and #14 over 300 watts, except for luminaires in concrete pour use #12 or larger or as shown. Conductors in channels of, and flex to fluorescent luminaires type THHN or XHHW.
F. Ungrounded System Wiring: All wiring connected to the secondary side of isolating transformers: Cross-linked polyethylene insulation with dielectric constant of less than 3.5; 30 mills minimum thickness, resistance constant greater than 20,000 at 60 degrees F, shall be suitable for wet and dry locations. Cable - G.E. No. SI-58053 or approved equivalent.
G. Color Code as follows and/or per local ordinances. Conductors #10 and smaller with colored insulation. Conductors #8 and larger not available in colors, color coded with colored pressure sensitive tape. Apply minimum 2" of tape to each individual [phase or neutral] conductor in half lapped pattern.
   H. Color-code as follows:

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<th>Phase</th>
<th>120/240 Volts</th>
<th>120/208 Volts</th>
<th>277/480 Volts</th>
<th>Ungrounded</th>
<th>Isolated Power 120/208</th>
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<td>Black</td>
<td>Yellow</td>
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<tr>
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<td>Brown</td>
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<td>Green / Black Stripe</td>
</tr>
</tbody>
</table>
I. Manufacturers of copper conductors: Phelps Dodge, Capital Cable, Southwire, Senator, United Copper, Cero Wire & Cable, American, or approved equal.

J. Manufacturers of aluminum conductors: Alcan “Stabiloy”, or approved equal.

PART 3 - EXECUTION

A. Install wiring complete with connections to equipment.

B. No wiring installed until after plastering and similar work is complete and dry.

C. Install wiring so conductors are not in tension in completed system.

D. Form wiring neatly and group in circuits. Tie grouped conductors with nylon ties, T&B "Tyrap" or approved equal.

E. Use pulling compound of Ideal “Yellow 77”, Minerallac No. 100, or approved equal. Do not use pulling compound for circuits on secondary side of ungrounded isolation transformers.

F. Join and terminate copper conductors individually.

1. Lugs in damp locations connected to copper bus: 98% conductivity copper or bronze Thomas & Betts "Locktite", Burndy "QA" or approved equivalent.

2. Lugs in damp locations connected to copper bus: Solid 98% conductivity long copper barrel, tin plated, compression type connectors, Thomas & Betts color keyed, Burndy "Hydent" or approved equal; applied with appropriate hydraulic tool.

3. Lugs in dry locations and lugs connected to aluminum bus - heavy casting aluminum, CU/AL rated, listed under UL Standard 486B, rated 90 degrees C; plated to prevent electrolysis, Thomas & Betts, Blackburn, Ilsco or approved equivalent.

G. Provide lugs where not furnished as part of equipment -furnish as specified above, to connect all conductors.

H. Furnish lugs for conductors #2/0 and larger with two bolt tongue or approved equivalent.

I. Make conductor taps #8 and larger from a second conductor with 98% conductivity bolted insulated connector, T&B "IDT", Ilsco "KUP-L-TAP" or approved equivalent. Insulate splices with 600 volt "heat shrink" covers T&B or equal.

J. Splice conductors #8 and larger with solid copper barrel, type fittings applied with an appropriate hydraulic tool. Splices used only where approved. Splice fittings: Burndy "Hydent". Insulate splices with 600 volt "heat shrink" covers T&B or equal.

K. Joints #10 and smaller: T&B Sta-Kon wire joints EPT66M, with insulating caps, installed with WT161 Tool or C nest of WT11M Tool; Ideal Super/Nuts; Ideal Wing Nuts; 3M "Scotchlock" or Buchanan Electric Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators installed with C24 pressure tool. Where conductors are connected to screw terminals, use nylon insulated, locking fork, T&B Sta-Kon or approved equal. Where joints are made in damp or wet locations insulate splices with 600 volt “heat shrink” covers T&B or equal.

L. Join and terminate aluminum conductors individually:

1. Lugs - heavy casting aluminum body, CU/AL rated, listed under UL standard 486B, rated 90 degrees C., plated to prevent electrolysis; Thomas and Betts, Blackburn, Ilsco, or approved equal. Provide two bolt tongue for #2/0 and larger conductors.

2. Splices - solid aluminum barrel, compression type; filled with no-oxide compound; Thomas & Betts, color keyed; Burndy "Hydent" or approved equal. Insulate splices with “Heat shrink” 600 volt covers, Thomas & Betts or equal.

3. Taps - heavy casting aluminum body, CU/AL rated listed under UL Standard 486B, rated
90 degrees C., plated to prevent electrolysis; Thomas & Betts, Blackburn; Ilsco or approved equal. Insulate to 600 volts with rubber, electrical tapes or preformed covers.

M. Provide cable supports: As required by NEC. Supports with malleable screwed conduit fitting and non-conductive wedges drilled for the conductors; O.Z. Manufacturing Company or approved equal. Furnish pullbox, sized per NEC for each cable support.

N. Bond circuit ground wires where installed to all devices, equipment, outlet and junction boxes, and grounding bushings (where provided) with a full size conductor and screw type connection.

O. Securely fasten non-ferrous identifying tapes, pressure sensitive labels or engraved nameplates to all cables, feeders and power circuits in vaults, pull boxes, manholes, switchboard rooms, terminations of cables, etc.

P. Mark all branch circuit conductors at panel terminations including neutrals with pressure sensitive numbers to correspond to circuit numbers connected.

Q. Connect circuits and feeders as shown on drawings. Drawings are diagrammatic and do not show every detail required in the wiring system. Detail wiring accomplished per NEC.

R. All conductors making up parallel feeders to be same size, same type, and same insulation, all cut same length. Bond each group of conductors making up a phase or neutral at both ends in an approved manner.

S. DO NOT COMBINE CIRCUITS unless specifically approved by the Architect. No more than 3 phase or current carrying conductors in a circuit.
SECTION 16121 - GROUNDING

PART 1 - GENERAL

1.1 SCOPE OF WORK:
A. Grounding Details

PART 2 - PRODUCTS

2.1 SYSTEM GROUNDING:
A. Bond and ground main service neutral, cabinets, equipment, conduits, metallic piping systems, etc., per the latest edition of NEC.
B. Ground conductors - 98% conductivity copper, either bare or with green THW insulation. Other conductor requirements same as described for low voltage, 600 volts, conductors.
C. Ground Connections:
   1. Make all ground connections with welded, brazed or soldered connections as shown.
   2. Use high alloy cast copper and/or silicon bronze mechanical connectors with Hex or Allen head bolts where permitted.
   3. Use Burndy "GAR"or approved equivalent.
   4. Size as required for piping connections.
   5. Thoroughly clean prior to installation of clamps and/or lugs.
   6. Use bolted or screwed on mechanical connectors. Do not use clip-on connections.
   7. Bond ground conductor to metal raceway at each end of the run.
   8. Seal connections between dissimilar metals (i.e.: bronze to steel), with approved epoxy resin.
   9. Coat connections with "No-OXID-A" compound as manufactured by Dearborn Chemical Company.
D. Provide lighting and power circuits larger than 20 amperes with green covered ground wire sized per NEC, or as shown, except not smaller than #12 AWG. Bond ground wire to all outlet boxes, junction and pull boxes, cabinets, equipment, etc., with self-tapping screw or bolt and appropriate lug. See Section covering "Raceways" for use of grounding bushing.

2.2 DRIVEN GROUND SYSTEM:
A. Provide driven ground rods and buried ground conductor interconnecting ground rods as shown on drawings and required by code.
B. Ground rods 5/8"x10'-0" 304 stainless steel. Ground rods installed with tops driven to 1'-6" minimum below grade. Connect ground wire to ground rod with Cadweld or equal.
C. Exterior buried ground conductor #2/0, soft drawn, bare, tinned copper, installed 2'-0" minimum below grade.
D. Bond all masses of metal, i.e.: pipes, conduits, fence posts, etc., within 6'-0" of the buried ground conductor to ground conductor with #6 AWG bare, solid, tinned copper wire, attached to object with appropriate clamp, lug, etc., (Cadweld or equal). Obtain complete set of drawings to determine quantity and location of required connections.
E. All connectors lugs, hardware, etc., for building ground system similar to that for other grounding as described above.
2.3 COMPUTER GROUND SYSTEM:

A. Provide radial isolated ground system for computer equipment as shown. Grounding systems shall be radial and isolated from each other to prevent formation of electronic loops. The grounding shall originate from the ground bus in central UPS distribution. This ground bus shall be designated the "ground window". The following ground system shall be complete and isolated:

1. Equipment ground (green wire).
2. Raceway system.
3. Raised floor ground.

B. Each system shall originate at the "ground window" and extend radially to all connections.

C. Test each system with 1000 VDC "megger" to prove isolation of different systems. Tests shall be same as described for feeders in Section 16010. Furnish readings between all ground systems and a reference ground selected by Architect.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUND 'GREEN WIRE CONCEPT':

A. Ground electrical equipment enclosures and conductor enclosures including metal raceways, outlet boxes, cabinets, switch boxes, motor frames, diesel engine frame, transformer cases, metallic piping systems such as water, gas, waste, air and metallic enclosures for all electrical equipment.

B. Provide separate grounding conductor for all circuits to insure adequate ground fault return path.

C. Install separate ground conductors in conduit.

D. Bond green wire to equipment enclosure at source and at apparatus served.

E. Insulate grounding conductors size to carry ground fault current safely. Minimum size for green wire grounding lead per N.E.C. or as indicated.

F. Do not use grounded current return conductors (neutrals) for equipment grounding. Connect common grounding lead to supply side of service disconnect unit only.

G. Do not ground neutral conductor after it has been grounded at service entrance, transformer or generator.

H. Maintain electrical continuity of conduit systems by threaded fittings with joints made-up wrench tight. Install insulated bushing and locknuts on terminating conduits. Provide conduits containing ground wires with grounding bushings bonded to ground wire with short full size jumper.

I. Provide receptacles with approved green covered bonding jumper from the grounding terminal screw connected to outlet box.

J. Install ground rods in quantity to provide a maximum of [5] ohms ground resistance. Where multiple rods required, separate a minimum of 6 feet and interconnect with wire of ground size shown.

K. Test ground systems as specified in Section 16010.
L. Install tags on ground connections to piping or electrode systems for all telephone equipment grounds.

END OF SECTION
SECTION 16127 - METAL CLAD CABLE (MC)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnishing and installing 600 volt conductors for lighting, power, and auxiliary systems in a spiral flexible enclosure designated MC-Cable per applicable NEC Article.

B. Furnishing and installing metal clad cable (MC) for branch circuit 20 and 30 amps in capacity for lighting and power circuits in areas with lay-in ceiling, and in stud walls where called for on drawings.

C. U.L. listed UL 1569 metal clad type MC cable

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. Conductor 98% copper #12 AWG minimum type THHN insulation manufactured and tested in compliance with UL-83; insulation resistance 6-1 megohms per 1000 feet.

B. Grounding conductors to be same size as phase conductors, and shall be insulated.

C. Jacket shall be galvanized steel, and shall be applied over the inner cable assembly with a positive interlock armor to wire grounding path in compliance with UL 1569 and NEC 517-13 [on healthcare use section 16128, 16581].

D. Circuit assembly shall be cabled (twisted) with suitable lay length, and covered with durable polyethylene terephtlate assembly tape.

E. Product shall be as manufactured by Galflex, AFC Cable, Southwire, or approved equal.

F. Color Code as follows and/or per local ordinances and as follows with colored insulation

<table>
<thead>
<tr>
<th>Phase</th>
<th>120/240 Volts</th>
<th>120/208 Volts</th>
<th>277/480 Volts</th>
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<tr>
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<tr>
<td>Eq Grnd</td>
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<td>Green</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

A. Install cable only above accessible ceiling and in stud walls. Do not run from floor to floor.

B. Installation shall be in accordance with applicable NEC Article. Support cable on 5-foot centers, and not more than 12-inches at box or cabinet. (Support independent of ceiling).

C. Fittings and connectors shall be products specifically designed for MC cable.

D. Joints #12 and smaller: T&B Sta-Kon wire joints EPT66M, with insulating caps, installed with WT161 Tool or C nest of WT11M Tool; Ideal Super/Nuts; Ideal Wing Nuts; 3M "Scotchlock" or Buchanan Electric Products B Cap or Series 2000 Pressure connectors complete with nylon.
snap on insulators installed with C24 pressure tool. Where conductors are connected to screw terminals, use nylon insulated, locking fork, T&B Stan-Kon or approved equal.

E. Bond circuit ground wires where installed to all devices, equipment, outlet and junction boxes, and grounding bushings (where provided) with a full size conductor and screw type connection.

F. Securely fasten non-ferrous identifying tapes, pressure sensitive labels or engraved nameplates to all cables, feeders and power circuits in vaults, pull boxes, manholes, switchboard rooms, terminations of cable, etc.

G. Mark all branch circuit conductors at panel terminations including neutrals with pressure sensitive numbers to correspond to circuit numbers connected.

H. Connect circuits shown on drawings. Drawings are diagrammatic and do not show every detail required in the wiring system. Detail wiring accomplished per NEC.

I. Circuiting where drawings do not show circuit conductors provide same as required to provide complete control and connections as designated by circuit numbers.

J. Install MC cable only above accessible ceilings and on drywall construction. Where conductors must pass thru or in non accessible and exposed area provide circuits in EMT or rigid as required by code.

K. DO NOT COMBINE CIRCUITS unless specifically approved by the Architect.

END OF SECTION
SECTION 16130 - OUTLET BOXES, JUNCTION BOXES AND GUTTERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Outlet, junction boxes, conduit bodies, wiring gutters and their installation.

PART 2 - PRODUCTS

2.1 OUTLET AND JUNCTION BOXES:

A. Provide wiring devices, fixtures and special system outlets with outlet box. Use galvanized steel for concealed boxes and exposed boxes in dry locations. Use cast iron conduit fittings similar to "Condulets" or "Unilets" with threaded hubs for exposed boxes outside and exposed to moisture.

B. Concealed outlets and exposed outlets in unfinished spaces for lights, switches, wall receptacles, etc.; consist of standard galvanized steel outlet boxes and plaster rings.

1. Provide 1/16" thick boxes and covers of form and dimension adapted to its specific use and location, kind of fixture to be used and number, size and arrangement of connecting conduits.

2. Provide 3/8" fixture studs where required.

3. Ceiling Outlet Boxes: 4" octagonal or 4-11/16" square as required, due to number of wires, and 2" deep minimum. Ceiling boxes in slabs concrete type. Plaster rings not required for ceiling outlet unless needed for device.

4. Paint junction boxes provided with blank covers to match surroundings, except use blank device plates in finished areas.

5. Switch and receptacle outlet boxes: 4" square with plaster rings as necessary. Provide multigang boxes where shown or required. Provide metal barriers to separate emergency and normal service wiring per N.E.C.

6. Steel City, Appleton, Raco, Bowers or approved equivalent.

C. Use galvanized cast iron boxes, approved equivalent to Crouse-Hinds type "FS" or Appleton condulets, with appropriate covers for wall outlets in exposed conduit work and exposed to moisture.

D. Use galvanized cast iron boxes equivalent to Crouse-Hinds type GRF for ceiling outlets in exposed conduit work exposed to moisture.

E. Use square cut steel outlet boxes for outlets exposed in finished locations. Use round or square to adapt to device installed. Wiremold, Hoffman or approved equivalent.

2.2 LARGE JUNCTION BOXES:

A. Furnish pull, tap and cable support boxes required by NEC for excessive number of 90 degree conduit bends, conductor taps and cable supports.

1. Box construction per NEC and manufactured with galvanized sheet steel, 12 gage minimum, with angle iron frame where required for rigidity; welded or bolted construction. Install bolts to prevent damage to cables in box.

2. Boxes with removable screw type covers and plated screws. Provide split covers where necessary for access. Maximum single piece cover - 36" x 36".

3. Provide separate junction boxes for each feeder. If conduit is installed so separate junction boxes are not practical, one large pull-box may be used with each set of feeder conductors separated by 12 gage steel barriers. Furnish junction box or each
compartment in junction box with ground lug for connection of ground wire.

2.3 CONDUIT BODIES:

A. Conduit bodies shall be installed to provide ease of pulling conductors and to provide neat appearance of conduit installation, and as shown on drawings. Conduit bodies constructed of malleable iron or copper free aluminum castings. Bodies shall be finished with standard durable exterior coatings of manufacturer specified. Provide rollers in type "C" and type "LB" bodies, 1-1/4" size and larger. Provide gasketed plated steel or malleable iron covers.

B. Conduit bodies shall be manufactured by Crouse-Hinds, Pyle National, Killark, Appleton or approved equivalent.

2.4 GUTTERS (Wireways):

A. 8" x 8" and smaller - use standard assembly manufactured by Square "D", Walker Electric, B&C Stamping Co., and General Electric. Make special and larger gutters of code grade galvanized sheet steel with hinged covers and approved fastening device.

2.5 SURFACE METAL RACEWAYS:

A. Where indicated on the drawings, wiring shall be run in exposed metal raceways, metal molding or wiremold complete with outlet boxes and fittings. All circuits run in surface metal raceways shall have a ground conductor with green insulation sized per the NEC, but not smaller than No. 12 AWG screw connected to each outlet box. All wiring in surface metal raceways shall be type "THWN" conductors.

2.6 TELEPOWER POLES:

A. Where indicated on the drawings, wiring shall be run in Telepower Poles, Wiremold or equivalent, complete with entrance end fittings, hanger clamps, trim plates, etc., as required. Poles shall be secured by means of a threaded rod attached to hanger clamp and to the structural ceiling above the grid. All circuits run in Telepower Poles shall have a ground conductor with green insulation sized per the N.E.C., but not smaller than No. 12 AWG connected to the screw terminal in the entrance end fitting and to the ground terminal on the receptacles in the pole.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTLET BOXES:

A. Fasten outlet boxes securely to structure.

B. Set all flush outlet boxes so edge of device flange is flush with finished surface.

C. Open no more knockouts in outlet box than required.

D. Seal boxes during construction.

E. Stagger back to back boxes 3" minimum. In rated walls use appropriate U.L. spacing.

F. Coordinate and verify rough-in location and mounting height of all boxes with drawings and other trades prior to installation.

G. Support All Boxes:

1. Outlet boxes - with 1/4" diameter galvanized rods or bolts anchored to structure.
2. Outlet boxes for surface mounted luminaires on furred ceilings with 3/4" channel iron
3. Fastened to ceiling channels. See Section covering "Luminaires".

4. Pull, junction and cable boxes with 3/8" diameter galvanized rods or bolts (4 minimum).

3. Pull, junction and cable boxes with 3/8" diameter galvanized rods or bolts (4 minimum).

4. Support outlet boxes in metal stud partitions with support that spans between two studs.

Caddy "SGB", "TSGB", or "RBS" hangers or equal.

H. Install adjacent outlets at different levels in one vertical line where possible.

I. Provide green covered bonding jumper, screw connected to outlet box in all receptacle boxes.

J. Paint wiring connections in ground mounted outlets or floor outlets in wet locations with "Scotchkote" and fill box with "Duxseal".

K. Mark outlet box covers with permanent ink markers to indicate circuit number(s) and panel of origination. Use black markers for normal service circuits and orange for emergency service.

L. Use 4" octagonal boxes with blank covers for master outlets, installed to permit installation of collars by others.

M. Where outlet boxes installed in unfinished concrete walls or columns, provide 1" deep plaster ring with box and ring set in position before the concrete is poured so concrete will fill around the ring and cover plate can be installed flush with the unfinished surface. In case of brick walls, follow same procedure with mason filling around the plaster ring with mortar.

N. Install all outlets located on columns on centerline of column and bend or shift reinforcing so that the outlet box will be flush with the finished concrete. Provide plaster rings as required so that the plate is flush with the finished plaster or exterior concrete surface.

O. Where outlets installed in waterproofed columns or walls, provide 6"x6"x3" deep wood box placed in the forms before concrete is poured. Box will be removed before waterproofing is applied. General Contractor will waterproof wall and opening, after which Electrical Contractor will install outlet box. General Contractor will grout around box. Set boxes carefully so that cover plates will be flush.

P. Install conduit bodies where shown or where required for sharp bends and/or aesthetics in raceway system. Do not use in lieu of pullboxes except in limited space or as directed by Architect.

3.2 INSTALLATION OF JUNCTION BOXES:

A. All junction boxes shall be accessible.

B. Securely fastened to structure.

C. Exterior below grade boxes shall be embedded 6" of concrete on sides and bottom. Top shall be level with finished grade unless shown otherwise.

D. There shall be no more knockouts opened in any box than are actually required.

E. Protection during construction.

F. Identify (See Section 16014).

3.3 INSTALLATION OF GUTTERS:

A. Mount gutters on 3/4" thick pressboard backboard, sized for devices to be mounted, 2 coats of Albi No. 107A fire retardant paint (install label on board), mount all equipment thereon.

B. Run conductors in gutter without reduction in size, entire length of gutter.
C. Connect individual taps from conductor to tapped device with ILSCO insulated tap devices sized for conductors used.

D. Gutter Tops: for copper conductors shall be ILSCO type GTA or PTA with GTC or PTC insulating covers or by “TEE” compression lugs as manufactured by Anderson or Burndy, wrapped with Scotch #33 electrical tape to a thickness which equals insulation level of wire.

END OF SECTION
SECTION 16134 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
   A. Lighting and power panelboards and their installation.

1.2 SUBMITTALS:
   A. Provide shop drawings. Include individual diagram of each panelboard showing all specified requirements.

1.3 RELATED SECTIONS:
   A. Surge Suppressors ......................................................... - Section 16315

PART 2 - PRODUCTS

A. Construct panelboards in accordance with latest NEMA and UL standards.

B. Panelboards to be same manufacturer as other distribution equipment.

C. Panelboard assembly UL labeled, and UL labeled as Service Entrance Equipment where used for that purpose.

D. Panelboards to have integrated equipment fault rating equal to interrupting rating of lowest rated overcurrent device.

E. Panelboards shall be factory assembled.

F. Bussing:
   1. 98% conductivity copper, silverplated at joints or equivalent plated 55% conductivity aluminum.
   2. Bus assembly designed for a maximum temperature rise of 55 degree C above 40 degree C ambient temperature when carrying rated current.
   3. Minimum thickness of bus bars - 3/32".
   4. Bussing braced to withstand a fault current equal to the highest device interrupting capacity in the panel.
   5. Neutral bus full size copper or aluminum sized on same basis as phase busses and insulated from the cabinet.
   6. Arrange bus bar connections so that adjacent vertical circuit protective devices are consecutively connected to phases A, B, and C throughout panel. Provide full capacity ground bus in each panel cabinet bolted to cabinet.

G. Cable terminations:
   1. Include neutral and ground connections as shown.
   2. Make with separate, individual heavy duty copper or bronze lugs Thomas & Betts "Lock-tite", solid copper barrel compression type, Thomas & Betts color keyed, Burndy "Hydent", or approved equivalent.
   3. Use 2 bolt tongue or equivalent connection to bus for #1/0 or larger cables.
   4. Securely bolt lugs to bus with bolts, nuts and lock washers.
   5. Provide double lugs on main bus where shown.
   6. Feed-through lugs (one set of lugs on each end of main vertical bus) is not acceptable unless approved by Architect.
H. Circuit breakers:

1. Molded case, thermal-magnetic, quick-make, quick-break, trip free on faults, thermal-inverse time delay element and magnetic instantaneous trip coil in each ungrounded phase conductor, or approved equivalent solid state trip unit.
2. Engrave breaker ampere rating on handle or trip unit.
3. Furnish multi-pole breakers with internal common trip.
4. Ground fault breakers class "A" type to trip on fault currents of 4-6 ma.
5. Main circuit breakers UL rated for service entrance use.
6. Switch "SWD" rated where required by NEC.

I. Fusible Switches:

1. UL approved for Service Entrance use.
2. Dual horsepower rated for AC and DC current.
3. Accepts standard One Time, Current Limiting, or Dual Element fuses.
4. Copper Fuse Clips, reinforced for good contact, mounted on insulated base.
5. Interlocked hinged cover. (Interlock defeatable with screwdriver).
6. Padlockable in "on" or "off" position.
7. Quick-make, quick-break mechanism with simultaneous operating poles.
8. Switch contact to be blade type, blow-off butt contacts acceptable only if manufacturer certifies contacts will remain closed under any fault conditions within limits of applied fuse.

J. Surge Protection Device / Transient Voltage Surge Suppression:

1. Panelboard shall be provided by UL 1449 listed and CSA 22.2 certified transient voltage surge suppressor where shown. The panelboard SPD/TVSS shall be tested and suitable for ANSI/IEEE C62.41 Cat. C1 (6kV, 3kA) environments.
2. Suppressor shall be included and mounted within the panelboards by the manufacturer of the equipment. See panelboard schedule for panelboard with TVSS.
3. The panelboard shall be constructed using a direct bus bar connection (no cable connection between bus bar and SPD/TVSS). Panelboards that use a wire connection do not meet the intent of this specification.
4. All monitoring diagnostics features such as indicator lights, trouble alarms and surge counter shall be visible from the front of the panelboard.

K. Panelboards classified by type over-current protection as follows:

1. BQL Bolted quick-lag circuit breaker distribution, 0-100 ampere branches, with minimum interrupting rating of 10,000 symmetrical amperes at 208 volts. Equivalent to Square "D", NQOD, Siemens NLAB, Cutler-Hammer BB, G.E. NLAB.

2. CCB Heavy duty convertible circuit breaker distribution, 0-800 ampere branches with minimum interrupting rating of 18,000 symmetrical amperes at 480 volts. Equivalent to Square "D", I-Line, Siemens CDP-6, Cutler-Hammer CDP, G.E. type CCB.

L. All space in panelboards usable. Panelboard space provided with necessary connections for future installation of overcurrent devices.

M. Identification:

1. Permanently attach nameplates and circuit numbers to panel.
2. Use horizontal circuit numbers for lighting and appliance panels unless shown otherwise on panelboard schedules.
3. Provide typewritten circuit directories describing service of each circuit in Types BQL and
4. Provide laminated plastic nameplate circuit identification for each circuit in Types CCB and CCB panels.

5. Provide each panelboard with nameplate showing name and voltage.

6. Provide each panelboard with identification of grounded and ungrounded branch-circuit conductors permanently posted. Refer Section 16120 conductors “color coding”.

N. Manufacturers:

1. Panelboards manufactured by Siemens, Square "D", General Electric or Cutler-Hammer.

2.2 CABINETS: (Same manufacture as interiors)

A. Code thickness, hot dip galvanized steel or painted with trim and door. Hardware: combination latch and cylinder lock, all keyed the same. Provide celluloid or plastic covered directory card holder on the inside of door. Trim, door and exposed interior shall be finished with factory prime and smooth finish coat of the color selected by Architect. Reinforce cabinets as necessary for service and short circuit rating intended.

B. Flush or surface as indicated of sufficient size to allow minimum 3" gutter space each side of panel and eight inches (8") at top and bottom, minimum 20" wide. Provide adjustable trim clamp, semi-flush hinges and inside rabbet.

C. Provide panels with hinged trim construction.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Mount panelboards securely to building structure with 3/8" minimum diameter galvanized bolts and inserts number as required for size of panel, but not less than 4. Mount panelboards with centerline 4'-6" approximately above finished floor. Where panels of different heights are mounted adjacent, install top of panel trim at same height above floor. Close all unused openings.

B. Where two sets of feeder cables are required in panel gutter space, run one set in each side of panel.

END OF SECTION
SECTION 16140 - SWITCHES AND RECEPTACLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Wiring devices and plates (receptacles, switches, Floor service outlets, poke-through assemblies, and multi-outlet assemblies) and their installation.

B. Related Sections:

1. Division 16 Section “Lighting Control Devices”

1.2 DEFINITIONS:

A. EMT: Electromagnetic interface

B. GFCI: Ground-fault circuit interrupter

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor

D. RFI: Radio-frequency interference

E. TVSS: Transient voltage surge suppressor

F. UTP: Unshielded twisted pair

1.3 SUBMITTALS:

A. Product Data: For each type of product indicated.

B. Shop Drawings: Listed legends and description of materials and process used for pre-marking wall plates.

C. Samples: One (1) for each type of device and wall plate specified in each color specified, as requested by Architect.

D. Field-quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction materials that include labeling conditions.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one (1) source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one (1) source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION:

A. Receptacles for equipment: Match plug configurations.
1. Cord and Plug Set: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:
   1. Hubbell
   2. Cooper
   3. Pass & Seymour
   4. Leviton
   5. Wiremold/Walker

2.2 DEVICES:

A. Furnish devices as shown in Table 1. Catalog numbers establish minimum standard of quality. Submit list of devices with catalog number proposed for review prior to ordering.

B. Use gray color, except in special areas designated elsewhere.

C. Special colors selected from standard available of almond, white, brown, black, or grey. Furnish color chart.
   1. Use red color for devices on essential power circuits.
   2. Use orange color for isolated ground receptacles, or as specified above with orange toggle on face.
   3. Use blue for TVSS devices.

D. Device Plates:
   1. Furnish devices with cover plates, 04" thick, type 302, stainless steel with brushed finish.
   2. Device plates in special areas to match device color.
   3. Furnish configuration of device plates required for multi-gang installations.
   4. Furnish weatherproof devices with individual gasketed aluminum or stainless steel covers U. L. listed for wet locations “In-Use”.

2.3 GFI RECEPTACLES

A. General Description: Straight blade, feed through type. Comply with NEMA WD 1, NEMA WD 6 UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

2.4 TVSS RECEPTACLES:

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449 with integral TVSS in line to ground, line to neutral, and neutral to ground.

   1. TVSS Components: Multiple metal-oxide varistors, with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
   2. Active TVSS Indication: Visual and audible with light visible in face of device to indicate device is “active” or “no longer in service.”
2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS:

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket, with green-insulated grounding conductor and equipment-rating ampacity, plus a minimum of 30 percent.

2.7 SNAP SWITCHES:

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 volt, 20 amp.

2.8 FAN SPEED-CONTROLS:

A. Modular, 120-volt full-wave, solid-state units with integral, quiet on-off switches and audible frequency, and EMI / EFI filters. Comply with UL 1917.

1. Continuously adjustable rotary knob 1.5A.
2. Three-speed adjustable rotary knob 1.5 amp.

2.9 FLOOR SERVICE FITTINGS:

A. Type: Modular flush-type dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable

2.10 POKE-THROUGH ASSEMBLIES:

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

1. Hubbell Incorporated; Wiring Device-Kellems
2. Pass & Seymour / Legrand; Wiring Devices and Accessories
3. Square D / Schneider Electric
4. Thomas & Betts Corporation
5. Wiremold Company (The)

B. Description: Factory-fabricated and factory-wired assembly of below-floor junction box with multi-channeled, through floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Pedestal type with services indicated.
2. Size: Selected for nominal 4-inch cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.
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<tr>
<th>DEVICE</th>
<th>NEMA CONF.</th>
<th>MANUFACTURER</th>
<th>CATALOG #</th>
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<td>HGF8300 w/ WP26M cover</td>
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PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster drywall joint compound, mortar, cement, concrete dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is towed flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or picking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300 without pigtailed.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-amp circuits, splice No. 12 AWG pigtailed for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Devices shall be installed secure, tight, and flush to the wall surface. Install outlet box extension plugs or spacers to bring device flush to surface.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: do not use oversized or extra-deep plates. Repair wall finishes and re-mount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: unless otherwise indicated, mount flush with long dimension vertical and with grounding terminals of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust location of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

2. Engraving shall be 1/4" high letters.

3. Color of letter fill corresponding to branch of electrical system:
   a. Black for Normal
   b. Red for Essential/Emergency
   c. Blue for UPS

4. Engrave all device plates for receptacles dedicated for utilization by specific equipment with name of equipment served ("X-ray", "Bed", "Copier", etc.)

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

7. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor and indoor photoelectric switches and daylight sensors.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
7. Wallbox-style dimmers.

B. Related Sections include the following:

1. Division 16 Section "Switches and Receptacles" for manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.2 TIME SWITCHES

A. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: SPDT (Single-Pole Double-Throw)
2. Contact Rating: 20-A ballast load, 120/208/240/277 Vac. Contact output for both maintained and momentary (pulse) to allow control of latching contactors.
3. Programs: 8 channels.
   a. For each channel, provide daily, weekly, or yearly schedules with a minimum of 1000 set points and an annual holiday schedule (up to 99 holidays) to override normal schedule.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program on selected channels.
5. Astronomical Time: User scheduled for on or off function of a program on selected channels.
6. Battery Backup: 8 year lithium battery.
7. Memory: All programming and time functions shall be stored in EEPROM non-volatile memory.
8. Surge Protection: Circuitry shall utilize transient voltage surge protection for voltage surges up to 6000V.
10. Approved Products: “Next Generation” series by Intermatic or equivalent by Tork.

B. Wallbox Time Switch: Digital programmable time switch, designed to replace a standard toggle switch, to turn lights OFF after a preset time period.

1. Completely self-contained control system, with standard single-gang switch device mounting and grounding strap with ground wire. Provide with compatible single-gang wallplate, color to match device (See section for “Switches and Receptacles” for device finish).
2. Switching mechanism shall be a latching air gap relay and utilize “zero crossing circuitry” to maximize relay life. Switch shall also be capable of operating as a manual ON-OFF switch.
3. Switch circuitry shall be compatible with all types of lighting loads, including tungsten, halogen, and fluorescent and HID ballasts (electro-magnetic and electronic).
4. Switch shall have no minimum load requirement and be capable of handling up to 800 watts (at 120 volt) or 1200 watts (at 277 volt) of lighting load.
5. Switch circuitry for time-off period shall be adjustable from 5 minutes to 12 hours (increments of 5 minutes up to one hour, and 15 minutes from 1 hour to 12 hours).
6. The time switch shall have optional warnings, including light flash and audible beep, for notifying occupant that the time-off period is expiring.

7. Approved Product: TS-400 by WattStopper or TD200 by Hubbell.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

A. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: Instant ON; 10-second delay OFF, to prevent false operation.
4. Mounting: Twist lock receptacle complying with ANSI/IEEE C136.10, with base mounting accessory as required to direct sensor to the North sky exposure.

B. Approved Product: K4536SS by Intermatic, or equal by Tork or Paragon.

2.4 INDOOR PHOTOELECTRIC SWITCHES

A. On/Off (closed loop) Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2150 lx), with an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.

5. Indicator: Two LEDs to indicate the beginning of on and off cycles.

6. Approved Product: Watt Stopper #LS100.

B. Dimming Control (Open-Loop) for Daylight Compensation: Electronic solid-state controller with separate photo-sensor to measure incoming light and proportionally adjust the dimmer output.

1. Controller Output to Dimmer: 0-10Vdc, compatible with dimming ballasts by Advance, Osram-Sylvania and Lutron. (Ecoyo Series)

2. Control system shall use open-loop algorithms to determine signal output to dimming ballasts.

3. Photosensor: 30-3000 fc monitoring range, low-voltage.


C. Dimming Control (Closed-Loop) for Daylight Compensation: Self-contained, ceiling-mounted control device that detects changes in light levels and raises or lowers electrical fluorescent lighting in response.

1. Controller output to fluorescent dimming ballast is 0-10Vdc, compatible with dimming ballasts by Advance, Osram-Sylvania, and Lutron (ECO10 series).

2. The photosensor shall be low-voltage, powered by 24Vdc power pack.

3. The photosensor shall utilize a photocell that measures only in the visual spectrum and has a response curve that matches the photopic curve. It shall not measure in the ultraviolet or infrared range (<5% for wavelengths < 400 nm or > 700 nm).

4. Sensor adjustments shall be made remotely with wireless remote control that shall be furnished with the product.

5. The photosensor shall have a control range of 20 –60 footcandles.


2.5 INDOOR OCCUPANCY SENSORS

A. Switch Box Sensors: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; (rated for 1000 W at 277-V ac).

1. Approved product: Wattstopper WI-200

B. Wall- or ceiling-mounting, sensor.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit. Sensor shall include auxiliary single-pole, double-throw isolated relay.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted though a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door or coverplate.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

a. Approved Bypass Switch: Wattstopper LVS-1 or approved equal.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling.
4. Approved Product: Wattstopper CI-300I (ceiling) CX-100 (Wall).

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on an 8-foot- (2.4-m-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Wall or Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Approved Product: Wattstopper DT-300 (ceiling) or DT-200 (wall).

F. Approved Occupancy Sensor Manufacturers: Leviton, Hubbell, Novitas, Sensor Switch, or Wattstopper.

2.6 MULTIPLE LIGHTING CONTACTORS

A. Approved Manufacturers:

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
4. GE Industrial Systems.
5. Square-D

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Control-Coil Voltage: Match control power source.

2.7 WALLBOX-STYLE DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120V, 60 Hz with continuously adjustable slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch (130-mm) wire connecting leads.
3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 1% of full brightness (depending on ballast-type).
4. Approved Manufacturers:
   a. Lutron, Nova-T series.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG.
C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG.
D. Provide unshielded, twisted-pair cable for control and signal transmission conductors.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install according to manufacturer’s instructions. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer’s written instructions.
B. Do not install ultrasonic or dual-technology occupancy sensors closer than 4 feet from air supply outlets / diffusers.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors." Minimum conduit size shall be 1/2 inch (13 mm).
B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Provide field-mounting transient voltage suppressors for lighting control devices locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring.

B. Label time switches and contactors with a unique designation. Provide a typewritten directory identifying circuits and spaces controlled by contactors.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test in compliance with manufacturer recommendations.

2. Operational Test: Verify actuation of each sensor and adjust time delays per manufacturer's instructions.

B. Remove and replace lighting control devices where test results indicate that they do not function properly.

C. Additional testing and inspecting, at Contractor's expense, may be performed to determine compliance of work with specified requirements.

3.5 ADJUSTING

A. Occupancy Sensor Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

B. Daylight Sensor Adjustments: Contractor shall provide on-site service to adjust sensors immediately after owner has occupied the space. An additional on-site visit shall be provided up to 12 months from date of substantial completion. At the end of the adjustment period, contractor shall turn-over accessories used for making adjustments, such as wireless remote controls, to the Owner.

END OF SECTION
SECTION 16160 - MOTOR STARTERS (Separately Mounted)

PART 1 - GENERAL

A. Separately mounted starters furnished and mounted under Division 16 except as follows:
   1. Main Chiller Starters.
   3. Package pumps and air compressors (see drawings).

B. Mount and wire starters furnished under other Divisions.

C. Provide shop drawings per Electrical Submittals sections.

PART 2 - PRODUCTS

A. Full Voltage Starters:
   1. Rated for 600 volts, 60 hertz and complete with thermal overload protection in each ungrounded phase conductor.
   2. Full voltage, non-reversing unless noted otherwise.
   3. Mounted in NEMA I, general purpose, or NEMA 3R, rain-tight, enclosure as shown.
   4. Shipped to job site without overload elements. Overload elements purchased based on the full load current of motor actually installed.
   5. Furnished with control devices as shown.
   6. Furnished with horsepower rated heavy duty disconnect switch combination where shown.

B. Manual Starters:
   1. Manual starters toggle operated with thermal overload protection in each phase conductor and rated 30 amps, 250 volts. Manual starters mounted in NEMA I or NEMA 3R enclosures as shown.

C. Reduced Voltage Starters:
   1. Autotransformer Type Starters:
      a. Free-standing, NEMA I enclosure, rated 600 volts.
      b. Closed transition type with voltage taps at 50%, 65% and 85%.
      c. Overload elements in each ungrounded conductor utilizing current transformers and overload relays calibrated for secondary CT current.
      d. Provide reset button, 120 volt control transformer (fused primary and secondary), control devices as indicated on drawings and auxiliary contacts as required.

D. Manufacturers: General Electric, Cutler Hammer, Square "D", or Siemens.

PART 3 - EXECUTION

A. Verify control devices required with Control Contractor prior to ordering starter. Furnish required devices.

B. Securely mount starters to building or equipment surface as shown. If location shown is not suitable for installing, provide necessary Unistrut P-1000 rack mounted as directed to secure.

C. Provide engraved nameplate showing item fed. Refer to Section 16014.

END OF SECTION
SECTION 16161 - MOTOR CONTROLLERS (Separately Mounted Variable Speed)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Furnish separately mounted variable speed (adjusted frequency) controllers as shown on drawings and specified herein.

B. Provide shop drawings complete with wiring diagrams and equipment information to reflect items specified herein.

C. Vendor shall have actively been manufacturing Adjustable Frequency Controllers for AC motors for a period of least five (5) years.

D. The Adjustable Frequency Controller shall be CSA certified and shall comply with the latest applicable standards of ANSI, NEMA, IEEE and the National Electrical Code.

E. Furnish drive with harmonic filter.

F. Entire assembly shall be U.L. listed and tagged.

PART 2 - PRODUCTS

2.1 CONTROLLER

A. Adjustable Frequency Controller to consist of 460 volt power supply unit with features, functions and options, as specified hereinafter and required by drawings.

B. Adjustable Frequency Controller rated as shown on the drawings. Controller shall be microprocessor based, designed to provide continuous speed adjustment of three-phase induction motors. The adjustable frequency output voltage shall provide constant volts per Hertz excitation to the motor terminals up to 60 Hertz.

C. Controller capable of converting incoming three-phase, 460 Volt (+ 10% to -5%) and 60 Hertz (+ 2 Hertz) power to a variable potential DC bus level. The DC voltage shall be inverted to an adjustable frequency output.

D. The inverter section of the controller shall use a total of six gate turn-off (GTO) thyristors with a minimum PIV rating of 1200 Volt or approved equivalent devices to generate six-step output.

E. The controller shall operate in an ambient temperature of 0oC to 40oC, an altitude of up to 3,300 feet above sea level and humidity of 0 to 95% noncondensing.

F. Controller enclosure: NEMA 1, force ventilated with filters, floor mounted. Controller front accessibility with easily removable assemblies.

G. All printed circuit boards in the regulator section shall be completely interchangeable for any rating of this model (7.5 HP through 300 HP) with the same set of optional features.

H. Provide following standard basis control functions:

1. Start, Stop, Power On indicating lights and manual door mounted speed control potentiometer.
2. Unidirectional operation, coast to rest on stop.
3. Adjustable linear independent timed acceleration and deceleration.
4. Full time torque limit, adjustable.
5. Two to 60 Hertz constant torque and 60 to 120 Hertz constant horsepower ranges with
the constant torque segment, adjustable up to 120 Hertz maximum with a properly selected motor.

6. Frequency stability of 0.5% for 24 hours with voltage regulation of + 2% of maximum rated output voltage.

7. Run, LED status indication.

8. Fused 115 VAC control power transformer for operator devices. Size transformer for all devices plus 50%. Fuse primary and secondary of transformer.


10. Five cycle logic power carry-over during utility loss.

11. Insensitive to input line rotation.

12. Fixed dwell time at start to increase motor starting torque.

I. Provide following protective functions:

1. Input AC circuit breaker with an interlocked, padlockable handle mechanism, rated 35,000 AIC @ 480 Volts.

2. AC input line current limiting fuses for fault current protection of AC to DC converter section and for additional fault current capacity.

3. Electronic overcurrent trip for instantaneous and inverse time overload protection.

4. AC input line under-voltage and phase loss protection.

5. Over-frequency protection.


7. Surge protection from input AC line transients.

8. Electrical isolation between the power and logic circuits, as well as between the 115 VAC control power and the static digital sequencing.

9. Seven segment alphanumeric diagnostic display of over frequency, instantaneous overcurrent, DC over-voltage, AC under-voltage/loss of phase, emergency stop, overload, over-temperature, inverter pole trip and stand-by modes, door-mounted.

10. Additional door-mounted status indicating LED's for self-diagnostics, including run, forward, reverse, phase loss, microprocessor fault, as well as board-mounted LED's, including one for each inverter pole gating signal, each inverter pole status and each logic level used.

11. Able to withstand output terminal line-to-line short circuits without component failure.

12. dV/dT and dI/dT protection for converter semiconductors.

J. Provide following independent adjustments:

1. Minimum speed: 2 to 40 Hertz

2. Maximum speed: 40 to 120 Hertz

3. Torque limit: 50 to 150%

4. Adjustable acceleration time: 4 - 120 seconds with 120 Hertz top speed setting.

5. Adjustable deceleration time: 4 - 120 seconds with 120 Hertz top speed setting.

6. Low frequency boost: 0 to 60 Volts at 2 Hertz.

7. Volts per Hertz - Adjustable from 3.83 to 11.5 Volts per Hertz.

K. In addition to the standard functions described above, furnish additional control, protective and adjustment functions as follows:

1. Provide door mounted, 2% accuracy, taut band meters for output amps (one phase), output voltage (line to line), and output frequency, calibrated 0 - 100% speed. Meters to read continuously when energized.


4. Provide isolated, with 4 - 20 ma process follow input, DC, analog signal.

5. Provide 4 - 20 ma DC analog process control output.

6. Provide motor slip compensation circuitry to maintain speed regulation to + 0.5%. Provide adjustment to vary compensation for 0% to 7.5% of 60 Hertz base speed.
7. Provide 3A, SPDT, 120 VAC relay output indicating:
   a. Fault trip
   b. Controller ready to run
   c. Motor running

8. Provide necessary auxiliary relays required for control circuitry shown.
9. Provide necessary circuitry to allow controller to restart automatically after loss of input power. Provide selector switch to select between automatic and manual restart.

L. Furnish one portable service analyzer to monitor the performance and operating conditions of the controller. The analyzer shall be capable of being plugged into any controller, regardless of rating without special modification and shall provide the ability to run, stop and control speed. The service analyzer shall indicate satisfactory operation or shall isolate the source of the malfunction to the smallest replaceable unit within the controller. Turn analyzer over to the Owner.

2.2 BYPASS CONTACTOR:

   A. A companion bypass panel shall be provided to allow servicing of the variable frequency drive without shutting down the air handling unit.

   B. The bypass panel shall be provided with dead front construction. The panel shall have a see-through, padlockable, hinged outer door to prevent unauthorized access to the drive or operators. The Dead front construction shall prevent accidental contact with high voltage while the drive is being operated or services.

   C. Bypass panel shall be provided with a door interlocked main input disconnect switch.

   D. Bypass panel shall be provided with a “drive-off-bypass” selector switch.

   E. Bypass panel shall be provided with a “Normal Operation-Off-Test” selector to facilitate static testing of the drive at startup or while it is operating in the bypass mode.

   F. Line, load, and bypass contactors shall be provided within the drive capable of interrupting the locked rotor rating of the driven motor. Bypass and load contactors must be mechanically interlocked to prevent simultaneous closure.

   G. Bypass panel shall be provided with overload relays.

   H. The bypass panel shall be provided with a fused 115 VAC control circuit transformer.

2.3 ENCLOSURE CONSTRUCTION

   A. Provide 1/4" x 2" x 6" ground bus for incoming and outgoing ground connections.

   B. Power terminations shall consist of copper compression type terminals for top or bottom entrance. See Section 16120.

   C. All enclosures shall be not less than 16-gauge steel, bent and reinforced for rigidity.

   D. Doors shall include device holders for mounting up to 12 operator devices. Factory-mounted operator devices shall be factory wired.

   E. Operating handle of disconnect shall always remain connected to the breaker. The operating handle shall not be mounted on the door of the enclosure, but on the controller for safe "stand-aside" operation. Position of operating handle will indicate On, Off, or Tripped condition of circuit breaker and include provision for padlock in Off position.

   F. Interlock provisions to prevent unauthorized opening or closing of the controller door with the disconnect in the On position. Provide screwdriver override.
G. The structure, when floor-mounted, shall be provided with adequate lifting means and shall be capable of being rolled or lifted into installation position and bolted to the floor.

H. Provide adequate conduit and wiring space per N.E.C. requirements.

I. External and internal painted steel surfaces shall be thoroughly cleaned and phosphatized prior to application of paint and primed with a corrosion-resistive coating.

J. Cabinet and door finish paint to medium textured, grey, inside and outside.

2.4 HARMONIC FILTERS:

A. Provide harmonic filters to match motors and starter design to limit harmonic currents from passing back into system.

B. Filters shall be factory installed and wired into starter all mounted in a common enclosure.

C. Filters shall be factory calculated to limit harmonics to industry standards. Furnish calculations with shop drawing.

2.5 TESTING

A. Each unit shall be factory tested in accordance with ANSI standards. Furnish Test Reports.

2.6 DRAWINGS

A. Furnish installation drawings with information such as weights, lifting instructions, storage instructions, mounting data, ventilation requirements, locations of electrical connections, types and sizes of power connections, location and sizes of ground terminations, locations and recommended use of shielded wire where required.

2.7 INSTRUCTION MANUALS

A. Instruction manuals with manufacturer's information and recommendation covering:

1. Receiving, unpacking and storing.
2. Controller characteristics such as: Ratings, conditions for applications and service, control functions, protective functions and options available or included.
3. Safety precautions and procedures before and during installation, starting adjustments and maintenance.
4. Environmental recommendations, including locating enclosed units in accordance with recommendations applicable to the as furnished NEMA designated enclosure.
5. Instruction manuals shall include connection data to permit removal and installation of recommended Smallest Replaceable Units.
6. External control and power wiring, including grounding.
7. Recommendations to optimize immunity to electrical noise.
8. Listing of phenomena external to the controller than can cause malfunctions or dangerous conditions, with suggested corrective actions.
9. Troubleshooting procedures with symptom/cause-effect and corrective recommendations, based on manufacturer's recommended Smallest Replaceable Units.

2.8 SAFETY AND WARNING LABELS:

A. Provide appropriate safety and warning labels inside and outside the controller, per NEMA ICS 3.1.

B. Include suitable warning labels inside and outside the enclosure in those cases where it is possible for the user to wire circuits into the enclosure that are not disconnected by the
disconnect device supplied by the manufacturer.

2.9 MANUFACTURERS:

A. Manufacturers: General Electric, Cutler Hammer, Square "D", Allen Bradley, Reliance, ABB or approved equivalent.

PART 3 - EXECUTION

3.1 SHOP DRAWINGS:

A. Furnish shop drawing of starters showing.

1. Size and weight.
2. Voltage.
3. Physical dimensions.
4. Control requirements.
5. Horsepower ratings.
6. All data to verify specifications.

3.2 INSTALLATION

A. Verify control devices required with Control Contractor prior to ordering starter. Furnish required devices.

B. Securely mount starters to Building or equipment surface as shown. If location shown is not suitable for installing, provide necessary Unistrut P-1000 rack mounted as directed to secure. Use minimum 4-3/8" bolts and inserts for each free-standing cubicle.

C. Provide engraved nameplate. Refer to section 16014.

3.3 EQUIPMENT SUPPORT:

A. The manufacturer shall provide startup calibration and assistance by a factory trained service technician and training for Owner personnel. Training shall be on site and shall be a minimum of 8 hours duration and shall be performed in addition to start-up of system. Training shall be scheduled with the Owner.

B. Provide a list of recommended spare parts and prices with shop drawings.

C. All units shall be warranted for a period of 24 months after acceptance by Owner. Warranty shall include any warranty expense incurred.

END OF SECTION
SECTION 16162 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

A. Provide motor control centers complete with control devices, motor thermal overload protection devices, circuit overcurrent protective devices, etc., as required for complete control of motors shown.

B. Motor control center shall be UL listed and conform to UL 845 and NEMA ICS-2.

PART 2 - PRODUCTS

2.1 MOTOR CONTROL CENTERS:

A. NEMA Class I, Type B construction with back to back or front only arrangement as shown.

2.2 CUBICLES:

A. 90" high, 20" wide and 14" deep (front only construction) or 20" deep (back to back construction), dead front, totally enclosed with rigid channel frame for free standing installation. Use manufacturers published standard steel construction, except 14 gage minimum. Entire control center primed and painted with two coats of light grey enamel. Provide following:

1. Vertical hinged door wiring compartments with access to each starter unit for power and control wiring.
2. Provide accessible pullbox compartments at top and bottom of each cubicle, for horizontal wiring between cubicles.
3. Provide conduit entrance space in top and bottom of each cubicle.
4. Use matching blank panels for unused space.

2.3 BUSSING:

A. 98% conductivity, silver-plated copper (or) equivalent 55% conductivity plated aluminum.

B. Run main bussing horizontally through cubicles with vertical riser busses for connection of starter units.

C. Vertical bussing rated 300 or 600 amperes based on size and rating of the starters connected, and rated to carry full connected load current.

D. Braced for 65,000 rms amperes symmetrical fault current at highest service voltage.

E. Provisions for incoming busway or cable as shown.

F. Arrange bussing for future sections.

G. Provide 1/4" x 2" copper ground bus to extend the full length of control center. Bolt to each cubicle.

2.4 COMBINATION STARTER-CIRCUIT PROTECTOR:

A. Plug-in type with stabs which increase contact pressure when subjected to short circuit currents.

B. Starter unit constructed to withdraw unit from cubicle without removing door.

C. Starter magnetic, full voltage or reduced voltage, non-reversing as shown, to conform to NEMA Industrial Control standards for horsepower served, NEMA size 1 minimum, with thermal overload protection provided in each ungrounded phase conductor.
D. Ship without overload elements and provide elements based on actual full load current of motor installed.

E. Provide starters complete with following:
1. Reset button in front cover to reset overload relays.
2. 120 volt control transformer with primary and secondary fuses.
3. Nameplate, white plastic with 1/4” high black letters describing service.
5. Pilot lights, 250 volt lamps: red-run, green-stop.

F. Control circuit disconnect relays consisting of oil tight relays number as required to disconnect all external sources of control voltage entering starter when breaker is open. Coordinate with Control Contractor. Relays located so all terminals in starter are de-energized.

G. Control Switches:
1. Provide control switch(es) on starters as shown on control drawings and/or called for in control specifications. Control devices - oil tight, industrial quality, mounted on starter door. Furnish minimum of one HOA control switch for each starter.
2. Auxiliary contacts as required for control scheme. Furnish 2-N.O. and 2-N.C. auxiliary contacts each starter minimum.
3. Enclose starter unit with hinged door.

H. Motor branch circuit overcurrent protection - motor circuit protector, MCP, in conjunction with the motor starter overload elements as follows:
1. Adjustable current sensitive coil in each phase to trip the protector on fault currents.
2. Minimum interrupting rating of 10000 rms symmetrical amperes at 480 volts.
4. Motor branch circuit and sub-feeder overcurrent protection provided by molded case, thermal-magnetic, quick-make, quick-break, trip free on faults, thermal-inverse time delay element and magnetic instantaneous trip coil in each ungrounded phase conductor, or approved - equivalent solid state trip unit.
5. Engrave breaker ampere rating on handle or trip unit.
6. Furnish multi-pole breakers with internal common trip.
7. Ground fault breakers class "A" type to trip on fault currents of 4-6 ma.
8. Main circuit breakers UL rated for service entrance use.
9. Switch "SW" rated where necessary.

I. Variable Frequency Drives
1. See 16161 for requirements.

J. Motor Control Centers: Standard product of General Electric, Square "D", Siemens, Cutler Hammer or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Coordinate entire installation with the mechanical and control contractors furnishing equipment, including verification of all motor sizes, voltages, control devices required, etc. Provide control devices as required.

B. Size overload elements per motor manufacturer's recommendation.
C. Mount motor control centers on 4" concrete pad and anchor to pad.

END OF SECTION
SECTION 16170 - DISCONNECTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Safety switches and disconnects and separately mounted circuit breakers.

B. Provide shop drawing.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES:

A. Heavy duty rated 250 or 600 volts as required; quick-make, quick-break operation; horsepower rated. If switch is not available with proper horsepower rating, classify switch as isolating switch only and provide nameplate reading "DO NOT OPEN UNDER LOAD". Operating handle interlocked with switch door to prevent opening door with switch closed. Provide mechanical over-ride for authorized personnel to open switch door without operating switch handle.

B. Fusible or non-fusible as shown. Furnish Bussman "Fuse-Tron" fuses for each fusible position, size as shown. Furnish 3 spare fuses for each size.

C. Furnish with provisions for locking with padlock. Enclosures for switches NEMA 1, general purpose, NEMA 3R, raintight, or special enclosure, as shown.

D. Standard product of Siemens, Square "D", General Electric, or Cutler Hammer.

2.2 SEPARATELY MOUNTED CIRCUIT BREAKERS:

A. Furnish and install separately mounted circuit breakers for overcurrent protection of feeders and branch circuits where shown on drawings.

B. Circuit breakers: Thermal-magnetic, molded case type, rated 600 volts, with interrupting rating of 10,000 rms amperes symmetrical minimum at 240 volts and 14,000 rms amperes symmetrical minimum at 480 volts.

C. Individual circuit breakers shall be mounted in NEMA 1, general purpose surface or flush enclosures as shown.

D. Circuit breakers shall be the standard product of G.E., Siemens, Square "D" or Cutler Hammer.

E. Lock-able switch.

PART 3 - EXECUTION

A. Secure disconnect switches to building or equipment surface as shown. If location shown is not suitable for installing, provide Unistrut P-1000 rack mounted as directed to secure switch.

B. Disconnects shall be located to be accessible and within 5 feet or closer to equipment served.

C. Provide engraved nameplates identifying equipment served, fuse or breaker size. Refer to spec section 16014.

END OF SECTION
SECTION 16171 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Documents: Drawings, General Conditions of the Contract and Division 01. Sections apply to this Section

B. Section 16073: Hangers and Supports for Electrical Systems

C. Section 16074: Vibration and Seismic Controls for Electrical Systems

D. Section 16180: Fuses

1.2 SUMMARY:

A. This Section includes the following individually mounted, enclosed, switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
5. Shunt-trip fused switches

1.3 DEFINITIONS

1. GD: - General Duty
2. GFCI: - Ground-Fault Circuit Interrupter
3. HD: - Heavy Duty
4. RMS: - Root Mean Square
5. SPDT: - Single Pole, Double Throw
6. HID - High Intensity Discharge

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
4. UL Listing for series rating of installed devices.
5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 16 Section “Electrical Supports and Seismic Restraints.” Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.”
The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field Quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition, include the following:
   1. Manufacturer’s written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES:

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Fusible switch, NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Non-fusible switch, NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.2 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES:

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front mounted, field adjustable trip setting.

3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.


C. Molded-Case Circuit Breaker Feature and Accessories:

1. Standard Frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment, Type HID for High Intensity Discharge lighting loads.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
5. Ground Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings push-to-test feature and ground fault indicator.
6. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:

1. Verify that accessories retained below are available and appropriate for molded-case switch types and ratings retained.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
3. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.

2.3 SHUNT TRIP FUSED DISCONNECT SWITCHES

A. Shunt-trip fused disconnect switch and accessories ![for elevator machine controller circuits].

B. Provide shunt-trip fused disconnect switch with all necessary relays, control transformer and other options as shown on drawings and listed below.

1. Ampere rating of the switch as indicated.
2. Short-circuit current rating of 200,000A with Class J fuses.
3. Interlocks to prevent the opening of the cover when the switch is in the ON position. Interlock shall be defeatable for testing purposes.
4. Handle lockable in OFF position.
5. 100VA control power transformer with primary and secondary fuses.
6. Isolation relay (SPDT, 120 amp, 120V): The coil of the isolation relay shall be 24V DC. A normal open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt-trip solenoid (140VA inrush at 120V). (Note: if 24V DC coil is selected, a separate 24V DC source and contact must be provided by the Fire Alarm Safety System.
7. Provide additional options as indicated below:
   a. Key to Test Switch
   b. “ON” pilot light (Green, Red, or White)
   c. Fire Alarm Voltage Monitoring Relay (comply with NFPA 72)
   d. NEMA 3R enclosure

C. Available Manufacturers:
   1. Cooper Bussman, Inc., Power Module Switch – P
   2. Ferraz Stewart, engineered fusible shunt-trip switch - ES

2.4 ENCLOSURES
   A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
      1. Outdoor Locations: NEMA 250, Type 3R.
      2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
   A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
   B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
   C. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."
   D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION
   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
   B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."
3.4 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges in accordance with overcurrent device study (see Division 16 Section "Overcurrent Protective Device Study").

3.5 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION
SECTION 16210 - FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Firestopping materials and accessories.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Basic Electrical Requirements Section 16010
B. Raceways Section 16110

1.3 CODES AND STANDARDS

A. Standard Building Code
B. Underwriters Laboratories - Fire Resistance Directory

1.4 QUALITY ASSURANCE:

A. Fireproofing Materials:
   1. ASTM E119 and/or ASTM E814 to achieve a fire rating as noted on Drawings.
   2. All fireproofing shall be UL classified for the appropriate UL system number.

B. Surface Burning:
   1. ASTM E84 with a flame spread smoke developed rating of 0/5.

C. Manufacturer:
   1. Company specializing in manufacturing the products specified in this Section with minimum three years experience.

1.5 SUBMITTALS:

A. Submit under provisions of Section 16010 - Electrical General.
B. Product Data: Provide data on product characteristics, performance and limitation criteria.
C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions. Include the UL System Numbers which apply to each application.
D. Conform to applicable code for fire resistance ratings and surface burning characteristics.
E. Provide certificate of compliance from authority having jurisdiction indicating approval.
F. Provide mock-up of applied firestopping material for each type of application.
G. If accepted, mock-up will demonstrate minimum standard for the work.
H. Mock-up may remain as part of the work.
I. Do not apply materials when temperature of substrate material and ambient air is below 40 degrees F.

J. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

K. Provide ventilation in areas to receive solvent cured materials. Use water based materials in occupied areas.

L. Sequence work to permit firestopping materials to be installed after and surrounding work is complete.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, grade, and UL label where applicable.

B. Coordinate delivery with scheduled installation date to allow minimum storage time at site.

C. Store materials in clean, dry, ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instructions.

1.7 GUARANTEE:

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fail in adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear or deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. 3M brand CP25 Fire Barrier Caulk, CS195 Composite Sheet, FS195 Wrap/Strip, RC-1 Restricting Collars, Interam Fire Dam 150 caulk or moldable putty. Other approved manufacturers are GE "Pensil" Systems and Dow Corning Fire Stop Systems.

B. Primer: Type recommended by firestopping manufacturer for specified substrate surfaces.

2.2 ACCESSORIES:

A. Dam Materials: Mineral fiberboard, mineral fiber matting, sheet metal or alumina silicate fire board.

PART 3 - EXECUTION

3.1 GENERAL:

A. Verify site conditions.

B. Verify that openings are ready to receive the Work of this Section.

3.2 PREPARATION:

A. Clean substrate surfaces of dirt, dust, grease, oil, loose materials or other matter which may affect bond of firestopping material.
B. Remove incompatible materials which affect bond.

3.3 INSTALLATION:
A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer’s instruction.
B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
C. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.
D. Protect materials from damage on surfaces subject to traffic.
E. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
F. Keep areas of work accessible until inspection by applicable code authorities.
G. Perform under this section patching and repairing of fire stopping caused by cutting or penetration by other trades
H. Install backing materials to arrest liquid material leakage.

3.4 APPLICATION:
A. Apply materials in accordance with manufacturer’s instructions.
B. Apply firestopping material in sufficient thickness to achieve rating to uniform density and texture.
C. Install material at floors, walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

3.5 CLEANING:
A. Clean up spills of liquid components.
B. Neatly cut and trim materials as required.
C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
D. Protect finished work.
E. Protect adjacent surfaces from damage by material installation.

3.6 SYSTEMS AND APPLICATION SCHEDULE:

<table>
<thead>
<tr>
<th>Construction Condition</th>
<th>UL Designation</th>
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</thead>
<tbody>
<tr>
<td>Metal Pipe or Conduit</td>
<td>C-AJ-1001, C-AJ-1007, C-AJ-1027, C-AJ-1044</td>
</tr>
<tr>
<td>Through Round Opening</td>
<td>W-J-1010</td>
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<tr>
<td>Metal Pipes or Conduits</td>
<td>C-AJ-1001, C-AJ-1006, C-BJ-1020, C-BJ-3017,</td>
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<tr>
<td>Through Large Opening</td>
<td>C-AJ-1044, W-J-1010</td>
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<td>Cables Through Opening</td>
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<td>Cable Tray</td>
<td>C-AJ-4003</td>
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<tr>
<td>Blank Opening</td>
<td>C-AJ-0004, C-AJ-0009</td>
</tr>
<tr>
<td>Non-metallic (Plastic) Pipe or Conduit Through Opening</td>
<td>C-AJ-2001</td>
</tr>
<tr>
<td>Metal Pipe or Conduit Through Gypsum Board Wall</td>
<td>W-L-1001, W-L-1016</td>
</tr>
<tr>
<td>Non-Metallic (Plastic) Pipe or Conduit Through Gypsum Board Wall</td>
<td>W-L-2002</td>
</tr>
<tr>
<td>Cables Through Gypsum Board Wall</td>
<td>W-L-3001</td>
</tr>
<tr>
<td>Metal Pipe or Conduit Through Wood Construction</td>
<td>F-C-1002</td>
</tr>
<tr>
<td>Non-Metallic (Plastic) Pipe or Conduit Through Wood Construction</td>
<td>F-C-2002</td>
</tr>
<tr>
<td>Cables Through Wood Construction</td>
<td>F-C-3001</td>
</tr>
</tbody>
</table>

A. The following sections have applications for fire ratings less than 2-hours: C-AJ-2001, C-AJ-5001, W-L-1001, W-L-2002.

B. The following sections have applications for fire ratings of 4-hours: C-AJ-5001, C-AJ-1007, C-BJ-1020, and C-BJ-3017.

C. All sections (including those previously listed) listed have applications for fire ratings of 2-hours or less.

END OF SECTION
SECTION 16310 - NEW OVERCURRENT PROTECTIVE DEVICES IN EXISTING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Install new overcurrent protective devices in existing switchgear, switchboards, motor control centers, and panelboards as shown. Provide all necessary components for complete installation.

PART 2 - PRODUCTS

2.1 FEEDER AND DISTRIBUTION PANELBOARDS:

A. Install new breakers in existing panelboards as shown. Breakers to be thermal magnetic, molded case with interrupting capacity and voltage rating to match existing breakers, or as noted on drawings.

2.2 HARDWARE:

A. Provide all necessary bus bars (same type as existing), drawout and plug-in assemblies, connectors, adapters for devices to fit existing space, new enclosure doors and panels, etc., as required for complete installation of new devices. All hardware shall line-up, and match existing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Modify existing buswork as required for new devices. New buswork braced and installed to match existing.

B. Identify all circuits (except lighting and receptacle panelboards) with laminated plastic nameplate fastened with 2 screws. Correct or retype directory schedules in existing lighting and receptacle panels.

C. New lugs: T&B "Lock'tite" or approved equal. Use two bolt tongue for cable #1/0 and larger.

END OF SECTION
SECTION 16315 - SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

1.2 RELATED WORK SPECIFIED ELSEWHER;

A. General electrical requirements - Section 16010
B. Grounding - Section 16121
C. Panelboards - Section 16134
E. Lightning Protection System - Section 16610

1.3 SUBMITTALS:

A. The surge suppression submittals shall also include upon request:
   1. Complete schematic data on each suppressor type indicating component valves, part numbers, conductor sizes, etc.
   2. Dimensional drawing of each suppressor type indicating mounting arrangements.
   3. Provide verification that the TVSS device complies with the required UL 1449 (IEEE C62.41 Cat. C1 - 6kV, 3kA) Surge Voltage Ratings (SVR).
   4. Provide test reports from a nationally recognized independent testing laboratory verifying that the suppressor(s) can survive the published surge current rating on a per mode and per phase basis. The test wave shall be the ANSI/IEEE C62.41, 8 x 20 microsecond current wave.

PART 2 - PRODUCTS

2.1 SEPARATELY-MOUNTED SERVICE ENTRANCE SUPPRESSORS:

A. Suppressors shall be listed in accordance with UL1449 2nd Edition, Standard for Safety, Transient Voltage Surge Suppressors.

B. SPD/TVSS Design:

   1. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
      a. Electrical Noise Filter: Each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be no less than 45 dB at 100 kHz using the MIL-STD-220A insertion loss test method. The unit shall be complimentary listed to UL 1283. Products not able to demonstrate noise attenuation of 45 dB @ 100 kHz as a minimum shall be rejected.
      b. Internal Connections: All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

C. Suppressors shall meet or exceed the following criteria:

   1. Maximum single impulse current rating (per phase): 250,000 amperes (8 x 20 us - waveform).
   2. Maximum single impulse current rating (per mode): 250,000 amperes (8 x 20 us - waveform).
3. Maximum Continuous Operating Voltage (MCOV):  The MCOV shall be greater than 115% of the nominal system operating voltage.

4. Protection Modes:  For a Wye configured system, the device must have directly connected suppression elements between line-line (L-L), line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G).  For a Delta configured system, the device must have suppression elements between line-to-line (L - L) and line-to-ground (L-G).

5. UL 1449 SVR:  The maximum UL 1449 (IEEE C62.41 Cat. C1 6kV, 3kA) SVR for the device must not exceed the following:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>WYE - L-N; L-G; N-G</td>
<td>400 V</td>
<td>800 V</td>
</tr>
<tr>
<td>Delta - L-L; L-G</td>
<td>800 V</td>
<td>1500 V</td>
</tr>
</tbody>
</table>

6. ANSI/IEE Cat. C3 Let Through Voltage:  The let through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for Cat. C3 surges (20 kV, 10kA) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>500 V</td>
<td>900 V</td>
</tr>
</tbody>
</table>

7. ANSI/IEEE Cat. B3 Let Through Voltage:  Let Through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 Ringwave (6 kV, 500 amps) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>170 V</td>
<td>300 V</td>
</tr>
</tbody>
</table>

D. Accessories:

1. Transient event counter with audible alarm and LED indicators.
2. Push-To-Test Feature:  Incorporate an integral test feature, which verifies the operational integrity of the unit’s monitoring system.

2.2 SEPARATELY-MOUNTED DISTRIBUTION/BRANCH SUPPRESSORS:

A. Suppressors shall be UL listed in accordance with UL1449, Standard for Safety, Transient Voltage Surge Suppressors.

B. SPD/TVSS Design:

1. Balanced Suppression Platform:  The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance.  The surge suppression platform must provide equal impedance paths to each matched MOV.

2. Electrical Noise Filter:  Each unit shall include a high performance EMI/RFI noise rejection filter.  Noise attenuation for electric line noise shall be no less than 45 dB at 100 kHz using the MIL-STD-220A insertion loss test method.  The unit shall be complimentary listed to UL 1283.  Products not able to demonstrate noise attenuation of 45 dB @ 100 kHz as a minimum shall be rejected.

3. Internal Connections:  All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

C. Suppressors shall meet or exceed the following criteria:
1. Maximum single impulse current rating (per phase):
   120,000 amperes (8 x 20 us - waveform).
2. Maximum single impulse current rating (per mode):
   60,000 amperes (8 x 20 us - waveform).
3. Maximum Continuous Operating Voltage (MCOV): The MCOV shall be greater than 115% of the nominal system operating voltage.
4. Protection Modes: For a Wye configured system, the device must have directly connected suppression elements between line-line (L-L), line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a Delta configured system, the device must have suppression elements between line-to-line (L - L) and line-to-ground (L-G).
5. UL 1449 2nd Edition SVR: The maximum UL 1449 (IEEE C62.41 Cat. C1 6kV, 3kA) SVR for the device must not exceed the following:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>WYE - L-N; L-G; N-G</td>
<td>400 V</td>
<td>800 V</td>
</tr>
<tr>
<td>Delta - L-L; L-G</td>
<td>800 V</td>
<td>1500 V</td>
</tr>
</tbody>
</table>

6. ANSI/IEEE Cat. C3 Let Through Voltage: The let through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for Cat. C3 surges (20 kV, 10kA) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>500 V</td>
<td>900 V</td>
</tr>
</tbody>
</table>

7. ANSI/IEEE Cat. B3 Let Through Voltage: Let Through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 Ringwave (6 kV, 500 amps) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>170 V</td>
<td>300 V</td>
</tr>
</tbody>
</table>

D. Accessories:

1. Transient event counter with audible alarm and LED indicators.
2. Push-To-Test Feature: Incorporate an integral test feature, which verifies the operational integrity of the unit’s monitoring system.

2.3 PANELBOARD & SWITCHBOARD-MOUNTED SUPPRESSORS

A. Panelboard shall be UL 1449 2nd Edition listed and CSA 22.2 certified approved as a transient voltage surge suppressor.

1. The panelboard SPD/TVSS shall be tested and suitable for ANSI/IEEE C62.41 Cat. C1 (6kV, 3kA) environments.
2. Suppressor shall be included and mounted within the panelboard by the manufacturer of the equipment.
3. The panelboard shall be constructed using a direct bus bar connection to the TVSS.
4. All monitoring diagnostics features such as indicator lights, trouble alarms and surge counter shall be visible from the front of the panelboard.
5. SPD/TVSS Design:
   a. Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
b. Electrical Noise Filter: Each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be no less than 45 dB at 100 kHz using the MIL-STD-220A insertion loss test method. The unit shall be complimentary listed to UL 1283. Products not able to demonstrate noise attenuation of 45 dB @ 100 kHz as a minimum shall be rejected.

c. Internal Connections: All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

6. Suppressors shall meet or exceed the following criteria:

a. Surge Current Capacity: Total surge current (based on an 8 x 20 microsecond waveform) that the device is capable of surviving shall not be less than:

<table>
<thead>
<tr>
<th>Panelboard Application</th>
<th>Min Surge Current Per Phase</th>
<th>Min Surge Current Per Mode *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Entrance (Switchboards, Switchgear, MCC)</td>
<td>240 kA</td>
<td>80 kA</td>
</tr>
<tr>
<td>High Exposure Roof Top Location</td>
<td>180 kA</td>
<td>60 kA</td>
</tr>
<tr>
<td>Distribution/Branch locations (Panelboards, MCC, Bus Duct)</td>
<td>120 kA</td>
<td>40 kA</td>
</tr>
</tbody>
</table>

* L-G, L-N and N-G (WYE System);
L-L, L-G (Delta System)

b. Maximum Continuous Operating Voltage (MCOV): The MCOV shall be greater than 115% of the nominal system operating voltage.

c. Protection Modes: For a Wye configured system, the device must have directly connected suppression elements between line-line (L-L), line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a Delta configured system, the device must have suppression elements between line-to-line (L - L) and line-to-ground (L-G).

d. UL 1449 SVR: The maximum UL 1449 (IEEE C62.41 Cat. C1 6kV, 3kA) SVR for the device must not exceed the following:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
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<td>800 V</td>
</tr>
<tr>
<td>Delta - L-L; L-G</td>
<td>800 V</td>
<td>1500 V</td>
</tr>
</tbody>
</table>

e. ANSI/IEE Cat. C3 Let Through Voltage: The let through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for Cat. C3 surges (20 kV, 10kA) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>500 V</td>
<td>900 V</td>
</tr>
</tbody>
</table>

f. ANSI/IEEE Cat. B3 Let Through Voltage: Let Through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 Ringwave (6 kV, 5000 amps) shall be less than:

<table>
<thead>
<tr>
<th>Modes</th>
<th>208Y/120</th>
<th>480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>L - N</td>
<td>170 V</td>
<td>300 V</td>
</tr>
</tbody>
</table>

7. Accessories:
2.4 POWERLINE CORD/DIRECT-WIRED (120 VAC) SUPPRESSORS:

A. Suppressors shall consist of a three-stage hybrid design. First stage M.O.V., second stage air-core 300 uh inductor, and third stage silicon avalanche diode.

B. The suppressor shall provide certified test data confirming a fail short failure mode.

C. Suppressor shall provide three suppression modes. Line to neutral, line to ground, and neutral to ground.

D. Suppressor shall provide a maximum single impulse current rating of 10,000 amperes (8 x 20 us - waveform) per mode.

E. Suppressor shall provide a pulse life rating of 3,000 amperes (8 x 20 us - waveform) every thirty (30) seconds for 2,000 occurrences.

F. Suppressors maximum clamping voltage when subjected to the ANSI/IEEE C62.41-1980, Cat. B (6kV-1.2 x 50 us, 3kA impulse) shall not exceed 450 volts peak.

2.5 PAIRED CABLE DATALINE SUPPRESSORS:

A. Maximum single impulse current withstand, conductor to ground or conductor to conductor: 10,000 amperes (8 x 20 us - waveform).

B. Pulse life rating: 3,000 amperes (8 x 20 us - waveform): 2,000 occurrences.

C. Maximum clamping voltage at 10,000 amperes, 8 x 20 us current waveform, shall not exceed the peak of the normal applied signal voltage by 200%.

D. Suppressors shall be a hybrid design with a minimum of three (3) stages utilizing solid-state componentry and shall operate bi-directionally.

E. The suppressor manufacturer shall provide certified test data confirming a fail short failure mode.

F. Suppressors shall be housed in an enclosure that is compatible with the system being protected.

2.6 APPROVED MANUFACTURERS:

A. Suppressors shall be manufactured by Advanced Protection Technologies, Current Technology, Intermatic, United Power, Cutler Hammer, Aegis Powerline or approved equal.

2.7 WARRANTY:

A. Surge suppressors shall be free of defects in material and workmanship and shall be guaranteed for a period of two years from the date of substantial completion.

B. Suppressors which show evidence of failure during the warranty period shall be repaired or replaced at no cost to the Owner.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE:
A. Provide a service-entrance suppressor at each utility service entrance to the facility, according to manufacturer’s recommendations.

B. Suppressor shall be installed on the load side of the first disconnecting point of the service.

C. Conductors between suppressor and point of attachment to the service-entrance equipment shall be kept as short and straight as possible, preferably close-nippled to the device being protected. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the device. Provide panelboard or switchboard-mounted suppressors whenever possible or as otherwise indicated.

D. Suppressor’s ground shall be bonded to the service entrance grounding conductor and grounded conductor.

3.2 DISTRIBUTION PANELS:

A. Install a secondary suppressor at each panelboard location as indicated on the drawings.

B. Conductors between suppressor and point of attachment to the panelboard shall be kept as short and straight as possible. Provide panelboard-mounted suppressors whenever possible or as otherwise indicated.

C. Separately-mounted Suppressors shall be installed with separate grounding and grounded conductors. The grounding and grounded conductor shall have no contact at this point unless the service panel is a "separately derived system" according to NEC 250-5(d).

3.3 ELECTRONIC POWER SUPPLY:

A. Install one each powerline cord or direct-wired branch circuit suppressor between each equipment item and its power supply conductors as follows:

1. Fire Alarm master panel
2. Building Management System headend
3. Security System headend
4. Telephone switch

B. Install suppressor according to manufacturer's recommendations.

3.4 ELECTRONIC EQUIPMENT PAIRED CABLE CONDUCTORS:

A. Install paired cable suppressors on each low voltage communication conductor according to C.1.a-g that exits the confines of the structure.

B. Suppressors shall be installed as close as possible, in a neat and workmanlike manner to the equipment requiring protection.

C. Where space permits suppressors may be installed within the equipment cabinet of the protected equipment.

D. The suppressors ground conductor shall be bonded to the AC power supply green grounding conductor. This bond shall additionally be bonded to the equipment metallic enclosure.

END OF SECTION
SECTION 16330 - TRANSFORMERS DRY TYPE

PART 1 - GENERAL

1.1 SCOPE:
   A. Dry type transformers with harmonic suppression system.
   B. Provide shop drawings.

PART 2 - PRODUCTS

2.1 SERVICE AND RATINGS:
   A. Transformers ventilated, for indoor service unless shown exterior, single or three phase as shown, with KVA rating shown.
   B. Voltage for 3 phase units 480V to 120/208V, three phase, four wire. Voltage of single phase units 480V to 120/240V, single phase, three wire. All units equipped with 2-2-1/2% FCBN and 2-2-1/2% FCAN taps. Special voltage transformation as shown.
   C. See 16331 for Harmonic Suppression System

2.2 INSULATION:
   A. Class-220 insulation, 150 degree C rise above 40 degree C ambient unless shown otherwise.

2.3 SOUND RATING:
   A. Maximum design sound level:

<table>
<thead>
<tr>
<th>KVA</th>
<th>DESIGN SOUND LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9.0</td>
<td>40 db</td>
</tr>
<tr>
<td>10-50</td>
<td>45 db</td>
</tr>
<tr>
<td>51 - 150</td>
<td>50 db</td>
</tr>
<tr>
<td>167 - 300</td>
<td>55 db</td>
</tr>
<tr>
<td>301 - 500</td>
<td>60 db</td>
</tr>
</tbody>
</table>

   B. Sound levels determined per NEMA and ASA Standards. Mount core and coils on vibration isolator pads.

2.4 MANUFACTURERS:
   A. G.E., Cutler Hammer, Square "D", Siemens.

PART 3 - EXECUTION

3.1 MOUNTING:
   A. Transformers up to 35 KVA may be suspended from building structural members on 4 steel rods unless shown otherwise. Mount height as directed. Provide extra supports required due to size and weight. No units wall mounted except as shown. Sizes above 35 KVA floor mounted.
   B. Use extreme care to eliminate noise and vibration. Suspended units; install in each rod, Amber/Booth type PBSR or Consolidated Kinetics type SRH vibration isolator size as directed.
   C. Floor mounted units smaller than 112.5 KVA: Mount on "Shear-flex pads, size as directed.
112.5 kVA and larger use spring isolators. Use seal-tight flexible conduit for final connections to transformers.

D. Shop drawings for each transformer to show physical size, conduit and cable space, connection diagrams, specified requirements, impedance, and maximum current inrush at rated voltage.

E. Unless labeled otherwise, transformer ventilation openings should be located at least 0’ - 6” away from walls or other obstructions to allow free circulation of air through and around each unit.

F. Shop drawings for each transformer to show physical size, conduit and cable space, connection diagrams, specified requirements, impedance, and maximum current inrush at rated voltage.
SECTION 16401 - SERVICE CHARACTERISTICS

PART 1 - GENERAL

1.1 RATING:

A. Secondary Service: 120/240 volts, 1 phase, 3 wire, grounded neutral.

B. 120/240 volts, 3 phase, 4 wire, grounded neutral, delta connected.

C. 120/208 volts, 3 phase, 4 wire, grounded neutral, wye connected.

D. 277/480 volts, 3 phase, 4 wire, grounded neutral, wye connected.

1.2 SERVICE AND UTILITIES:

A. Arrange with local electric service company for service to be brought to project, and for the installation of meter. Pay all charges (if any) in connection therewith, including permanent meter deposit, which deposit will be refunded to Contractor at time of Owner's occupancy of the building.

B. It is responsibility of this Section, prior to bid, to re-affirm with Utility Companies involved, that locations, arrangement, Power Company voltage, phase, metering required, and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, contract price shall include an additional cost necessary to meet those regulations without extra cost to Owner after bids are accepted.

C. Obtain from Utility Company any additional charges for service of type, size and location called for. Include charges in bid to be paid by Contractor to appropriate party. Provide payment of these charges so as to allow logical progression of construction and avoid delay of completion.

D. Should cost above not be available prior to bid, submit with bid a letter signed by responsible Utility Company personnel stating that cost is not available. Prime Contractor shall submit letter with his bid to Owner. Cost will then be omitted from contract and become responsibility of Owner.

E. Furnish with shop drawings a signed document from each utility company describing location and type of service to be supplied and requirements for service. Document shall be signed by the appropriate responsible representative of the respective Utility Company.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 TRANSFORMER VAULT SERVICE:

A. New service to facility consists of underground primary service from riser pole(s) to new transformer vault(s) with secondary service from the transformer(s) to new main switchboard.

B. Power Company furnishes and installs following:

1. All facilities on the primary riser poles.
2. Primary cable from the riser pole to the primary switches and transformers complete with
3. Primary switches and transformers complete.

C. Power Company furnishes following to Electrical Contractor for installation:

1. Primary PVC duct for installation in concrete as described below. Contractor receives duct from Power Company warehouse and transport to job site.
2. Ground rods and ground wire for installation of loop in transformer vaults as shown.

D. Furnish and install following service related items:

1. Primary duct bank from riser pole to transformer vault(s). Duct bank consists of PVC duct, furnished by Power Company, encased in concrete as shown. Use long radius 36" minimum, polyvinyl chloride, elbows same as duct. Terminate ducts at pole with cast iron double hubs as directed by the Power Company. Terminate duct in transformer vault wall with flared, flush end bells. See Section covering "Raceways".

E. Coordinate service work with Power Company, and install work in accordance with their requirements and recommendations.

3.2 PAD MOUNTED TRANSFORMER SERVICE:

A. Service to facility consists of underground primary service from riser pole to new pad mounted transformer, with underground secondary service from transformer(s) to main distribution equipment.

B. Power Company furnishes and installs following:

1. All facilities on primary riser pole.
2. Primary cable from the riser pole to pad mounted transformer complete with connections at each end.
3. Pad mounted transformer complete.

C. Provide the following:

1. Primary duct bank from riser pole to transformer. Duct bank consists of PVC duct encased in concrete as shown. See Section covering "Raceways". Use long radius, 36" minimum, PVC elbows, same as duct. Terminate ducts at pole with cast iron double hubs as directed by Power Company. Terminate ducts in transformer pad with approved bushings.
2. Transformer pad: Build transformer pad to Power Company's specifications. Pad consists of 3000# concrete reinforced with #4 steel bars 12" o.c. in both horizontal directions. Provide 1" x 45 degree chamfer on all top edges. Obtain detail drawings from Power Company for location of anchor bolts, and complete pad details. Pad construction to conform to the Power Company details. Provide two 3/4" x 10" copper clad steel ground rods in pad as shown.
4. Coordinate all service work with Power Company and install the work in accordance with their requirements and recommendations.

3.3 UNDERGROUND SERVICE TO POLE:

A. New secondary service to facility consists of underground conduit and conductors from new riser pole to main distribution equipment as shown.

B. Provide creosoted southern yellow pine, riser pole, size and class as shown.
C. Terminate conduit at pole with screw-on galvanized weatherheads, T&B or equal. Terminate service conduits above Power Company service drop with conductors forming drip loop before connection to drop.

3.4 OVERHEAD SERVICE:

A. Service to the building, overhead as shown. Provide necessary supports members secured to the structure to fasten service mast. Service rack furnished by Power Company, but installed by Electrical Contractor.

B. Secondary service consists of conductors in conduit terminated inside in main distribution equipment and terminated at service drop with appropriate weatherheads equivalent to OZ Manufacturing Company, screw-on, rigid conduit type. Terminate service conduit above service drop attachment and provide conductor extension for drip loop before conductors are connected to service drop.

C. Arrange with Power Company for this service and install service in accordance with their requirements and recommendations.

3.5 METERING:

A. Install devices and conduit for Power Company metering of secondary service as shown. Power Company will furnish meter, meter socket, donut CT's and meter conductors to Contractor for installation. Install any additional conduit, junction boxes, etc., as required by Power Company.

B. Install meter equipment in accordance with Power Company requirements.

END OF SECTION
SECTION 16510 - LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
   A. Furnish and install all lighting luminaires, with all necessary accessories and lamps, as shown, specified, and/or scheduled.

1.2 RELATED SECTIONS:
   A. See Section for Lighting Control Systems.
   B. See Section 16010 or Section 16012 for requirement for submittals.
   C. See Division 1 for allowances and Owner-furnished items to be installed under this Section.

1.3 ABBREVIATIONS:
   A. H.I.D. - High Intensity Discharge (High Pressure Sodium, Mercury Vapor, Metal Halide)

1.4 SUBMITTALS:
   A. Shop drawing submittals for luminaires shall include the following for each luminaire: complete construction details including all dimensions, complete description of materials used, complete electrical data (including operating voltage), photometric test report from an independent testing lab, complete description of finish, and manufacturer catalog cutsheet of lamp to be used.

PART 2 - PRODUCTS

2.1 LUMINAIRES:
   A. Furnish and install luminaires as shown in luminaire schedule, or otherwise indicated on the drawings. Manufacturer catalog numbers shown are for general descriptive purposes only, and are intended only to establish the standard of quality.
   B. Locations of luminaires on electrical drawings are diagrammatic. Verify location of luminaires with architectural drawings prior to installation. Conflicts between electrical and architectural drawings shall be referred to the Architect for resolution.
   C. Provide luminaires complete with all options, accessories and other appurtenances required for a complete installation. Contractor shall verify type of ceiling and wall construction being installed, and provide luminaires properly configured for the type of construction.
   D. All luminaires shall be UL listed for the application being installed.
   E. Exit signs shall be furnished with 6" high letters with ¾" stroke. Verify color of signage required by local code authorities. Signs shall meet all NFPA, UL and local building code requirements.
   F. Pendant stem mounted luminaires shall be furnished with ball aligner swivel, 30 degrees from vertical minimum, with swivel below canopy, with ½" diameter metal tube (stem).
   G. Plastic lenses and shielding shall meet NFPA and local building code requirements for light transmitting plastics.
   H. Metal luminaire housings shall be free of tool marks, dents, burrs and sharp edges. All metal parts shall be painted, galvanized, or otherwise corrosion-resistant.
I. Reflector surfaces shall be finished specular, semi-specular, diffuse or painted as indicated. Specular finish materials shall have a minimum reflectance value of 83%. Semi-specular or diffuse finish shall have reflectance of 75% and white painted finish materials shall have reflectance of 88%.

J. Luminaire support wires shall be zinc-coated, soft temper ASTM A641/A641M steel, 12 gage.

K. Luminaires with aircraft cable suspension system shall use 1/16” diameter (minimum) stainless steel aircraft cable and adjustable cable gripper with swaged cable stop at ceiling canopy. Cable size shall be selected by luminaire manufacturer to provide adequate support.

2.2 BALLASTS AND TRANSFORMERS:

A. All ballasts and transformers used in luminaires shall be ETL approved and/or UL listed. Transformers for low-voltage lighting systems shall be UL listed for that application.

B. Interior ballast noise level essentially quiet in normal ambient noise level.

C. Provide fuse for each ungrounded conductor supplying each ballast or transformer.
   1. Fluorescent: provide GMF/HLR fuse of proper size/rating for each ballast.
   2. H.I.D.: provide HEB/KTK fuse of proper size/rating for each ballast.

D. Ballasts provided to function without interruptions when operating in room ambient temperature of 80 degree F. and plenum operating temperature of 120 degree F.

E. Luminaires installed in environments with ambient temperature below 32 degree F shall be provided with ballast appropriately rated for the ambient environment.

F. Ballasts for each lamp type shall use a consistent form factor for all luminaires throughout the project using that lamp type.

G. Luminaires with ballasts that can be serviced in place shall incorporate a means to disconnect the conductors supplying the ballast in compliance with 2005 N.E.C. Article 410.73(G).

2.3 FLUORESCENT BALLASTS:

A. Electronic Ballast: Instant - start, std THD:
   1. Furnish fluorescent luminaires with rapid start lamps and high-frequency electronic ballast.
   2. Ballast shall be high frequency (20 khz or greater), operate lamp without detectable flicker and provide full light output. Ballast shall operate lamp within ANSI guidelines for lamp starting and lamp operation. Ballast shall be warranted for five (5) years. Ballast shall be “universal voltage” (able to operate 120V or 277V.) Ballast shall incorporate circuiting to detect “end-of-life” of lamp and shut down ballast operation.
   3. Ballast shall comply with FCC and NEMA limits governing EMI and RFI, and shall not interfere with the operation of other electrical equipment. Total harmonic distortion shall be less than 20%. Power factor shall be greater than 0.95. Ballast/lamp combination shall meet the following (T8 lamps are used to establish level of performance. Provide ballast required to properly operate with lamp specified in luminaire schedule or as required by luminaire manufacturer):
      a. T8 Lamps:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Ballast Factor</th>
<th>Ballast Efficacy Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-lamp</td>
<td>0.88</td>
<td>1.46</td>
</tr>
<tr>
<td>3-lamp</td>
<td>0.88</td>
<td>1.00</td>
</tr>
<tr>
<td>4-lamp</td>
<td>0.85</td>
<td>0.75</td>
</tr>
</tbody>
</table>
4. Approved Ballast Manufacturers:

2.4 COMPACT FLUORESCENT BALLASTS:

A. Electromagnetic Ballast (13 watt or less):
   1. Compact fluorescent luminaires with pre-heat type lamps (integral starter) shall be furnished with compatible electromagnetic ballasts.
   2. Ballast shall be equipped with UL recognized non-PCB containing capacitor, and a core and coil protector. Ballast shall be high power factor, UL listed Class P, and shall operate lamps within ANSI guidelines for lamp starting and operation.

B. Electronic Ballast (13 watt and higher):
   1. Compact fluorescent luminaires with rapid start lamps (without integral starter) shall be furnished with programmed rapid start electronic ballasts.
   2. Ballasts shall be series wired, THD<10%, minimum starting temperature of 0°F, maximum case temperature of 70°C, and allow remote mounting up to 18 feet. Ballast factor to be 0.95 –1.05 for Normal Light Output. Ballast input voltage shall be Universal Voltage (120V through 277V).
   3. “Triple-tube” (aka. PLT, “hex” tube, or CFM) compact fluorescent lamps shall be furnished with electronic ballast that will operate 26, 32, or 42 watt lamps.
   4. Approved ballast manufacturers: Advance, Universal, Robertson, Osram/Sylvania.

C. Compact Fluorescent Dimming Electronic Ballasts.
   1. Electronic dimming ballast shall have a continuous flicker-free architectural dimming range of 100% - 1% relative light output (RLO) for T4 4-pin compact fluorescent lamps.
   2. Electronic dimming ballast shall have:
      a. a ballast factor greater than .95
      b. total harmonic distortion (THD) less than 10% at full light output.
      c. Electronic dimming ballast shall utilize 3-wire (line voltage) phase control technology for ballast dimming.
   3. Electronic dimming ballast shall maintain constant light output +/-2% for a line voltage variation of +/-10%.
   4. Electronic dimming ballast shall not be damaged by miswires between any input power and control connections and any lamp leads to each other and/or ground.
   5. Approved Product: Lutron Hi-Lume.

2.5 HIGH INTENSITY DISCHARGE BALLASTS:

A. Metal Halide:
   1. Furnish Metal Halide luminaires with Auto-Regulating or Constant-Wattage Auto transformer ballast. Ballast shall be high power factor (PF > 0.9) and operate lamp within ANSI standards for lamp starting and operation. Ballast shall regulate lamp power within 10% with line voltage variation of +/- 10% and shall keep lamp energized with line voltage drop not exceeding 30%.
   2. Furnish pulse start luminaire / lamp system where indicated. Pulse start ballasts shall be linear-reactor on super CWA type.

B. Furnish High Pressure Sodium luminaires with Auto-Regulating ballast. High color-rendering High Pressure Sodium lamps shall be provided with magnetic regulating ballasts. Ballast shall be high power factor (PF > 0.9) and operate lamp within ANSI standards for lamp starting and
operation. Ballast shall regulate lamp power within 3% with line voltage variation of +/- 10% and shall keep lamp energized with line voltage drop not exceeding 30%.

C. Approved HID Ballast Manufacturers:

1. Advance, Universal, Valmont, Venture.

2.6 LAMPS:

A. Furnish lamps for all luminaires as specified in Luminaire Schedule, otherwise provide lamp as recommended by luminaire manufacturer.

B. Lamps shall be new, delivered to the project site in their original packing, and shall be of the same manufacturer for each luminaire type. Install lamps immediately prior to Owner's occupancy. Do not use lamps for construction purposes.

C. Warranty lamps as follows:

1. Incandescent - one month.
2. Fluorescent and HID - one year
3. Warranty begins from date of substantial completion.
4. All lamps shall be free of defects and covered by an implied warranty based on industry-accepted lamp mortality. Lamps failing at a higher than normal rate shall be replaced upon determination of cause of failure or defect.

D. Incandescent lamps:

1. Standard Shape A-lamp shall be medium base, 120 volt rated, inside frosted. Provide 120V lamps for dimmed circuits.
2. PAR lamps shall be medium base, 120 volt rated quartz-halogen.
3. Provide 120 volt lamps for dimmed circuits. Use infrared (IR) conserving lamps whenever possible.
4. Low-Voltage Quartz-Halogen lamps shall be 12 volt with cover glass. We Infrared (IR) conserving lamps whenever possible.
5. MR-16 lamps shall have metalized reflector to minimize color shift between lamps. Osram/Sylvania "Titan", or G. E. "Constant Color Precise".

E. Fluorescent Lamps:

1. All fluorescent and compact fluorescent lamps shall be compatible with ballast provided with luminaires to operate lamp within ANSI and NEMA guidelines. Provide lamps with low mercury content (federal EPA TCLP compliant a.k.a. “ECO” or "ALTO").
2. T8 lamp type: lamps shall have an average rated life of 20,000 hours, minimum of 2800 lumens and 75 CRI.
3. Compact fluorescent (T4) lamp type: Compact fluorescent lamps shall either be single, double or triple tube type with 4-pin bases for operation on electronic and dimming ballasts. Where available lamps shall contain end-of-life sensing to prevent overheating of lamp base and sockets. Lamps shall have a minimum CRI of 82.
4. Compact fluorescent (T5) lamp type: Lamps shall have a 2G11 base and operate on electronic ballasts. Lamps shall have a minimum CRI of 82.
5. Linear T5 fluorescent lamp type: All linear T5 fluorescent lamp types shall have miniature bi-pin bases, 20,000 hours average rated life, a minimum CRI of 82.

F. High Intensity Discharge (HID) Lamps:

1. All high intensity discharge lamps shall be operated on the appropriate ANSI designated electromagnetic ballast in accordance with ANSI C82.4.
2. Metal halide lamps: All metal halide lamps used in interior applications shall be coated, unless otherwise noted in the lighting fixture schedule. Otherwise, provide clear or coated lamp as recommended by luminaire manufacturer. All metal halide lamps used in open aperture luminaire shall contain a protective shroud / other suitable containment material for use in open fixtures (“O” rated).

3. High pressure sodium lamps: All HPS lamps shall have an average rated life of 24,000 + hours. All HPS lamps shall have a lead-free solderless base, to provide superior electrical contact in lampholder throughout lamp life.

4. Low pressure sodium lamps: All LPS lamps shall have a non-metallic bayonet base for safe re-lamping, sodium retaining reservoirs, U-bend insulation to control lamp wattage rise, arc tube support system to protect arc tube from shock and vibration, uniform indium oxide heat reflecting coating, barium getter, triple coil electrodes and a fuse coil in the lamp base.

G. Approved Lamp Manufacturers:


2.7 EMERGENCY LIGHTING:

A. Provide luminaires and exit signs with self-contained battery power supplies as indicated. All equipment shall conform to UL924-Emergency Lighting and Power Equipment.

B. Battery shall be sealed, maintenance-free lead-acid type (indoors) or nickel-cadmium (outdoors or unconditioned spaces) with 10-year nominal life. Unit shall incorporate a fully-automatic solid state charger and automatic transformer relay to transformer to backup battery power supply upon failure of normal power.

C. Fluorescent emergency ballasts shall be self-contained battery-inverter units mounted within the luminaire housing. In emergency operation, lamps shall operate continuously for a minimum of 90 minutes. Once normal power is restored, the unit shall automatically transfer to charging mode. The ballast shall produce light output (minimum) as follows:

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>Lumen Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>F32T8</td>
<td>1350 Lumens</td>
</tr>
<tr>
<td>FT40</td>
<td>900 lms</td>
</tr>
<tr>
<td>CFM42W/32W</td>
<td>750 lms</td>
</tr>
<tr>
<td>CFQ26W</td>
<td>600 lms</td>
</tr>
</tbody>
</table>

D. All emergency lighting equipment shall be equipped with means to test operation and an LED indicating battery status.

E. H.I.D. luminaires indicated for use as emergency lighting shall be provided with an auxiliary system to produce light instantly when the primary lamp momentarily extinguishes or is being initially energized (“quartz restrike”). The auxiliary system shall consist of an incandescent quartz-halogen lamp socket, time-delay relay, and current-sensing device so that the auxiliary lamp turns off once the primary lamp reaches 60% of normal light output.

2.8 POLES AND STANDARDS:

A. Poles should conform to AASHTO LTS-3 standards for structural design. Poles shall be designed to withstand prevailing wind conditions with a gust factor of 1.3.

B. Pole manufacturer shall coordinate with luminaire manufacturer to ensure adequate strength to support the fixtures specified. Pole shall be furnished with all appropriate mounting hardware, fasteners and supports for installation of the luminaire(s).
C. All pole hardware and fasteners shall be stainless steel or other corrosion-resistant materials if stainless steel is not compatible with structural material.

D. Pole manufacturer shall provide a plywood or steel anchor-bolt template to assist installer in preparing pole foundation. Template shall indicate luminaire orientation to ensure proper light distribution.

E. Provide power-installed screw foundation where indicated. Screw foundation shall be fabricated with hot-dip galvanized structural steel (ASTM A36/A36M) of sufficient strength to support pole and luminaire. Mounting plate and bolts shall be coordinated to match pole.

F. All poles shall be provided with a wiring handhole per National Electrical Code requirements.

G. All poles shall be provided with grounding lug bonded to metal components of the pole. The lug shall be accessible through the handhole.

H. All poles shall be furnished with anchor bolt/base plate covers. Cover shall match pole match pole material and finish.

I. Steel poles shall be pre-finished inside and out, either hot-dip galvanized or prime-coat enamel to prevent corrosion.

J. Wood poles, provided as indicated, shall be pressure-treated southern yellow pine and shall be straight and smooth. Provide galvanized steel mounting hardware for luminaires and surface-mounted rigid galvanized conduit for luminaire wiring. Provide NEMA 3R hinged cover box at the base of the pole for wiring terminations and fuse holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support luminaires from structure of the building, independent from the ceiling membrane or finish material. Luminaire shall be set level, plumb, and square with ceilings and walls.

B. Recessed lay-in luminaires in suspended grid ceilings shall be supported from the ceiling grid. Provide devices for securing the luminaire to the ceiling grid to comply with the National Electrical Code ("earthquake clips"). Luminaires heavier than 30 pounds shall have supplemental support wires anchored to the structure above the ceiling.

C. Recessed luminaires in fire-rated ceiling assemblies shall be installed in accordance with the UL listing of the assembly.

D. Recessed luminaires (non lay-in or hard ceiling types) shall be supported by ¾” steel ceiling channel, or factory-supplied hanger bars one on each side of the luminaire, anchored to ceiling structure. Recessed luminaires heavier than 20 pounds shall have supplemental support anchored to the structure above the ceiling. Do not use conduit to support luminaire.

E. Provide recessed luminaires with appropriate frames, hardware and trim for the ceiling installed.

F. Install luminaires free and clear of structural and mechanical interferences above the ceiling. If location indicated on the drawing conflicts with other elements, notify the Architect for directions for remedial action.

G. Attach surface and pendant mounted luminaires to 3/16" fixture stud in outlet box. Luminaires in excess of 20 pounds shall have supplemental support anchored to the structure above the ceiling.
H. Luminaires surface mounted to grid-type ceilings shall be mounted with Caddy IDS type clips anchored to structure above.

I. Wall mounted luminaires shall be anchored to wall structure. Luminaire shall fully conceal the outlet box.

J. Wiring to luminaires shall be with flexible metallic conduit to junction box. Do not wire luminaire to luminaire unless noted otherwise, or if using manufactured wiring systems.

K. Individual flexible connections under 6 feet in length shall consist of 2#14 and 1#14 (ground) in 3/8" flexible metallic conduit (for circuits 20A or less). Bond ground wire and conduit at each end.

L. Recessed luminaires in insulated ceilings shall be installed so that insulation is no less than 3 inches away from the fixture enclosure unless the luminaire is listed for direct contact with insulation (IC rated).

M. Provide equipment, labor and materials, as needed for final aiming of adjustable luminaires. Aiming shall take place immediately before final occupancy by the Owner.

N. Exterior pole-mounted luminaire with anchor base type poles shall be installed on a reinforced concrete foundation designed to withstand fixture weight and prevailing wind conditions. Conduit raceway shall be pre-set in the foundation and terminate inside the pole.

O. Provide a copper-clad steel grounding rod, installed and bonded at each lighting pole.

P. Exterior pole-mounted luminaires with direct-embedment type poles shall be installed in carefully compacted earth per pole manufacturer's recommendations.

Q. All poles shall be installed so that the pole is plumb to the earth, with the bottom of the base flush to the foundation, paving, or finished grade, unless indicated otherwise. Verify soil conditions at each pole location to ensure adequacy of soil to support pole. Advise Architect if soil conditions are not adequate.

R. All pole-mounted luminaires shall have in-line fuse installed at the hand hole of the pole with weatherproof fuse holder. Provide sufficient slack in conductors to allow servicing outside of pole.

S. Reflectors, trim cones, and other visible trim of luminaires shall not be installed until completion of ceiling work, and shall be clean and free of dust, fingerprints, scratches, dents etc. upon substantial completion.

END OF SECTION
SECTION 16610 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

A. Furnish and install all materials and labor required to provide a complete functional lightning protection and common ground system for the building as shown and detailed on the plans, in strict accordance with this section of the specifications and the applicable contract drawings.

B. Completed system shall bear UL master label “C”.

1.2 STANDARDS AND QUALITY ASSURANCE:

A. The following specifications and standards of the latest current issue form a part of this specification.

1. N.F.P.A. - Code No. 780.

B. All materials for this system shall be new and the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be of the latest approved designs. Equipment shall be approved for UL listing. All materials shall be as manufactured by Thompson Lightning Protection, Inc. of St. Paul, Minnesota, Robbins, Harger, or approved equal. For approval of manufacturer other than specified, complete proposed material data and installation drawings must be submitted to Architect for review not less than 10 days prior to bid date.

C. In order to insure integrity of installation, the system shall be installed under the direct job site supervision of Certified Master Installer.

1.3 SHOP DRAWINGS:

A. Complete shop drawings of the entire lightning protection system showing the type, size, mounting details, and location of all equipment, grounds and cable routings, etc., shall be submitted to the Architect for approval prior to start of work. If any departures of consequence from the Approved Shop Drawings are deemed necessary by the Contractor, details thereof shall be submitted and approval obtained, before work is resumed and completed.

1.4 SYSTEM:

A. System materials in general shall be copper and high copper-content bronze castings, and shall comply in weight, size, and composition for the class of structure to be protected, as specified in above mentioned Codes. The system shall consist of all necessary cables, air terminals, mounting bases, fittings, couplings, connectors, fasteners, etc., as required to give a complete and coordinated system. All cable and all air terminals shall bear proper UL labels.

B. Supplier of system shall review all drawings to obtain all items required to be connected to system. Drawings show only main aspects of system. No extra compensation will be allowed for coverage and connectors required to meet NFPA 780.

C. System conductors shall be completely concealed wherever practical. All main downleads and roof risers shall be concealed within the building walls or columns, on new work or extensions to existing structures. Downleads and risers to be run in 1” PVC conduit in locations shown on Shop Drawings. Down leads in steel frame buildings shall be bonded at the top and bottom. Install suitable junction boxes in conduit system for bonding taps which shall be made with full-size conductor. Rebar steel in these columns shall be lapped a minimum of 24 diameters and ties shall be installed per A.S.T.M. standards.
D. All system fittings except cable holders, regardless of Structure classification shall be heavy-duty type made from bronze castings and secured with bolted-pressure clamps. Pressure plates made from stamped or pressed metal parts, or fittings utilizing crimp-type pressure devices will not be allowed. All bolts, screws and related type hardware shall be stainless steel.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. All materials shall be copper or copper alloys as described above, UL approved and labeled as required, and of the size, weight, and construction to suit the application where used in accordance with Code requirements for the Class of structure involved, and as per manufacturer recommendations.

B. Air terminals shall be solid, 1/2" diameter round copper bar, full nickel plated, and of sufficient length to project 10" minimum above the object to be protected, and UL labeled. Locate and space points in accordance with L.P.I. requirements.

C. Point bases shall be cast bronze with bolt-pressure cable connectors. Parapet type units shall provide for 1-1/2" coping overhand. Adhesive type bases for flat roofs shall have a minimum surface contact area of 18.5 square inches, and be secure with a proper adhesive.

D. Conductors shall be braided smooth twist or rope-ay stranding commercially pure copper cable, sized per Code and UL labeled.

E. Ground rods shall be 3/4" diameter and 10'-0" long copper-clad steel, connected to system downlead cable with two-bolt bronze clamp with stainless steel cap screws. Driven depth to be minimum of 12 feet.

F. Cable fasteners shall be substantial in construction, compatible with the conductor and mounting surfaces, and spaced according to Code requirements.

G. Bonding devices, cable splicers, and miscellaneous connectors shall be cast bronze with bolt pressure cable connections with stainless steel hardware. Any connections between dissimilar metals shall be made with approved bi-metallic connectors or spacers.

PART 3 - EXECUTION

3.1 SYSTEM DESIGN: (When no drawings are to be made)

A. Contractor shall have supplier of system design system in accordance with these specifications furnishing shop drawing for approval.

3.2 INSTALLATION:

A. All equipment and materials shall be installed in a neat workmanlike manner by skilled installers, under the direct field supervision of a Certified Master Installer who has qualified under the LPI's Certification Program or similar installation training.

B. System installation shall be complete; including necessary cable networks on the roof for air terminals and devices, bonding networks and taps for grounding equipment and roof metals, and downlead conductors routed concealed in building structure to ground level. Where downleads and risers penetrate roofs and walls, suitable 1/2" copper rod type thru-roof connectors shall be used, equipped with necessary lead or neoprene washers and nuts for watertight seal. Copper pitch pockets shall be used at locations with built-up roofs. Adhesive-type point bases and cable holders shall be installed on build-up roof areas before application of roof gravels.
C. System installers shall thoroughly coordinate their work with other trades to insure a correct, neat, and unobtrusive complete installation.

3.3 BONDING AND SYSTEM GROUNDS:

A. A common ground shall be provided between the lightning protection system and the building electric and telephone service grounds. In addition, all underground metallic piping systems shall be bonded with full size conductor; including water, gas, sewer, fuel oil, and any other piping system, at points where these pipings enter the building.

B. The building electrical service shall be provided with a set of lightning surge arresters, secondary as required. Only valve type arresters will be acceptable, either single or three-phase as required.

C. Bonding of all metallic objects and systems at roof levels and elsewhere on the structure shall be complete. Primary bonds for metal bodies of conductance shall be bonded with appropriate fittings and full-time conductor; and shall consist of but not limited to the following: Roof exhaust fans, HVAC units with related piping ductwork, exhaust vents and any other roof piping systems, cooling towers, elevator hoist machinery supports and rails systems, window washing tracks, antenna mast for TV, radio or microwave, flag poles, roof handrails and/or decorative screens, roof ladders, skylights, metal stacks, etc. Exterior architectural metal fascia and/or curtain walls or mullions, which extend the full height of the structure shall also be bonded, if not inherently bonded thru the building frame.

D. Metal bodies of inductance located within six feet of a conductor or object with primary bonds, shall be bonded with secondary cable and fittings. Typical of these are: plumbing vent stacks, roof flashings, parapet coping caps, gravel guards, isolated metal building panels or siding, roof drains, down spouts, roof ventilators, exterior balcony handrails, lower level sizeable miscellaneous metals, etc.

3.4 SUPERVISION AND CERTIFICATION:

A. The manufacturer's local representative shall be a Certified Master Installer and shall provide direct jobsite technical supervision to Contractor's personnel during installation to insure compliance with all Code requirements.

B. Upon job completion, Contractors shall furnish Owners with written certification plus UL Master Label "C", that system is installed in compliance with above Codes.

3.5 SHOP DRAWINGS:

A. Shop drawing as-built with certifications by master installer shall be turned over at close out.

END OF SECTION
SECTION 16703 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and General Provisions of Contract including General and Supplementary Conditions and other Division 1 Specifications apply.

1.2 RELATED SPECIFICATION SECTIONS:

Section 15010 .......................................................... HVAC
Section 15440 .......................................................... Plumbing
Section 16010 .......................................................... Shop Drawings
Section 16110 .......................................................... Raceways
Section 16130 .......................................................... Outlet Boxes
Section 16134 .......................................................... Panelboards

1.3 DESCRIPTION OF WORK:

A. This section covers the furnishing, installation and testing of a complete Addressable Fire Alarm System which includes actuation devices, notification appliances, and actuation devices which cause other Code or operations functions to occur, such as air handling unit shut down and fire door/shutter operations and necessary wire and conduit.

B. Voice Alarm:

1. Provide a complete Voice Alarm System for assembly area under normal use where function is occurring in one of these areas, actuation of automatic devices in or out of area shall cause general alarm throughout.

2. When area is used for specific function with designed use, an alarm outside the area or inside the area shall provide a chimed notice of alarm, and if alarm is not responded to within sixty (60) seconds, a pre-recorded message sounds which says, “A fire condition has occurred. Please exit building through the nearest exits. Prior to automatic message, supervisor of space may provide similar message through voice alarm control panel microphone that is remotely routed in the protected area.

C. This section requires all conduit and wiring to support complete Fire Alarm System. Drawings do not show conduit and wiring requirements. This information is to be supplied to Contractor by Fire Alarm Supplier, both prior to bids for inclusion in pricing and specifically in Shop Drawing.

D. Contractor is required to review all Contract Documents for connections of other systems to Fire Alarm for Code required operations. Items such as held-open fire/smoke doors, smoke/fire dampers, elevator recall, hood suppression system, smoke evacuation fans, etc.

1.4 SYSTEM OPERATION:

A. System non-coded, general alarm.

B. Electrically supervise system against both short and open wiring faults in detection circuits, alarm circuits, and internal control panel faults. Short or open wiring faults occurring in circuits will cause audible and visual trouble indication at control panel.

C. System functions as follows when an actuation device is initiated:

1. Audible alarm devices will sound continuously. Visual alarm devices will flash.

2. Proper zone and fire indications will appear on main control panel and remote
annunciators.
3. Circuits to energize or de-energize equipment power control circuits will be actuated as indicated. Kitchen Equipment under hoods and supply fan Shut down HVAC Equipment.
4. Circuits to electrically held smoke and fire doors will release doors.
5. Digital communicator will notify a U.L. listed central system if connected.
6. Closing of sprinkler valve will cause audible and visual signal at Annunciator(s) Supervised Location, but will not initiate Fire Alarm.
7. Actuation of sprinkler flow valve will initiate system.

1.5 MANUFACTURER’S REQUIREMENTS:
A. System shall be supplied, installation supervised and tested by an Authorized Factory Dealer located within seventy (70) miles of project site. Submit evidence of same with Shop Drawings.
B. Submit complete Shop Drawings of system for review including terminal-to-terminal connection diagram, conduit diagrams, technical information on each item of equipment, and any other information required to describe system. Identify color code and terminal numbers on Shop Drawings.
C. Manufacturer’s trained Technical Representative shall supervise installation, connections, and test. Before acceptance, Manufacturer’s Representative will certify in writing system is installed and functioning properly as intended by Drawings, Specifications, and Code. Test includes operation of all devices.
D. Guarantee system in writing for one (1) year from date of acceptance. Guarantee covers parts and labor.

1.6 CODES:
A. The Fire Alarm Systems shall comply with requirements of NFPA Standard No. 72 and NFPA 70, Article 760 for protected premises signaling systems, except as modified and supplemented by this Specification. The system shall be supervised either electrically, or by software-directed polling of field devices.
B. The system shall also be listed by Underwriter’s Laboratories under the category Control Unit System (UOJZ) and Control Unit Accessories (UOXX).
C. The Fire Alarm System shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001 and ANSI/ASQC Q9001-1994.
D. System shall comply with all local Codes. Modification of design to meet same is required and no additional compensation will be allowed for compliance. See execution section for devices to assist in this.

PART 2 - PRODUCTS
2.1 MANUFACTURERS:
A. Entire system shall be the product of one (1) Manufacturer.
B. Specifications list products or equal products of Notifier, Edwards, Cerberus, or approved equal are acceptable.

2.2 ADDRESSABLE SYSTEMS:
A. System shall consist of main control panel and ![voice control panel] complete with batteries and charger to support system operation and all required components and factory installed surge suppression on power input.
B. System Capacity:
   1. 196 addressable alarm or alarm or IDNET points
   2. 6 standard appliance circuit
   3. Walk test
   4. Panel programming
   5. Sensor maintenance alert
   6. Ground fault assistance

C. System Components:
   1. System Control Panel:
      a. Notifier AFP400 True Alarm digital communication module for remote monitoring
         with built-in surge suppressor on power feed.
   2. Voice Control Panel:
      a. Supervised remote microphone with key switch and ready-to-talk LED with built-in
         batteries and charger.
   3. Remote Annunciator: (LCD Type)
      a. LCD-40
   4. Initiation Modules:
      a. Manual pull station, addressable, double action, break glass;
      b. Heat detectors, addressable; rate of rise for normal temperature application 135°
         fixed with 15° rate of rise.
      c. Heat detectors, addressable; rate of rise high temperature application 155°
         fixed with 15° rate of rise.
      d. Smoke detector, photo-electric, addressable.
      e. Duct detector, photo-electric, addressable with sampling tubes, housing, and
         remote status/test station with progressable relay for air handling unit shut down.
         (1) Appropriate length sampling tubes.
         (2) For air conditioning units 2000 CFM and larger.
      f. Monitor module, addressable, to monitor devices internal to Fire Alarm such as
         hood fire suppression panel, fire pump operation, generator running, etc.
      g. Control module, addressable, to operate (turn ON or OFF) external devices such
         as trip elevator breaker, etc.
   5. Sprinkler Flow Switch:
      a. Connection only to switch installed by others
   6. Where Manufacturer model numbers are not mentioned, use standard published device
      (modified as required by Specification) complying with Specifications of item described.

2.3 ALARM INDICATING DEVICES:

A. Strobe Alarm Lights:
   1. White lens mounted in faceplate (to meet ADA requirements), rated 24 VDC; 75 candela
      minimum lamps; electrically supervised, identified with lettering "FIRE" on unit.

B. Strobe Light/Speaker
   1. 75 candela minimum power lamp horn; 87 dba at 10 feet; in one faceplate;

C. Strobe Light/:
1. 75 candela minimum

D. Where Manufacturer’s model is not indicated for alarm devices, use system Manufacturer’s standard published device which complies with Specification.

2.4 MISCELLANEOUS DEVICES:

A. Sprinkler Valve Supervisory Switch/Valve Supervisory Switches:

1. Shall be provided and wired by the Electrical Contractor under this section. Valve switches shall be suitable for the application O, S & Y, or PTV Type and shall mount to the valve.

PART 3 - EXECUTION

3.1 COMPLETE SYSTEM REQUIREMENTS:

A. Review entire control documents for items requiring connection to or operation by the fire alarm system to meet and comply with all local and national codes. This includes Architectural, HVAC, Plumbing, and Fire Protection. Items requiring connection to fire alarm are the responsibility of this section whether shown on electrical documents or not.

3.2 SUBMITTALS:

A. After review of documents prepare shop drawings as described. Including items not shown on drawings.

B. Submit shop drawings to local building authorities for their review and approval. Incorporate review comments prior to submission to engineer for review.

C. Submit Shop Drawings consisting of, but not necessarily limited to, the following:

1. 1/8 inch scale floor plans showing all devices; the required type and number of conductors with conduit size.

2. Plans shall specifically cover:
   a. Initiation of system by manual pull stations and automatic functions such as smoke detectors, heat detectors, flame detectors.
   b. Initiation of system by kitchen hood fire protection system(s).
   c. Initiation of system by elevator smoke and heat detectors and elevator recall and power shut down.
   d. Initiation of systems by sprinkler system flow valves and trouble signal by sprinkler system supervisory switch.
   e. Monitoring of:
      (1) Fire pump
      (2) Emergency generator
      (3) Kitchen refrigeration system
   g. Unlocking of electrically controlled exit and internal egress doors.
   h. Each visual device shall be furnished with candela requirements for application with candela power shown by device.
   i. Each audible device shall be furnished with Db rating required for application with Db rating shown by device.

3. Where contractors review of all contract documents and/or local Codes require devices not shown, use devices listed in Attic Stock to supplement drawings. If Attic Stock is exceeded, notify Architect in Shop Drawing submittal.

4. Elevation of “Fire Alarm Control Panel” (central control station), and each transponder with location of each component and Manufacturer’s descriptive cutsheet of that.
component. Provide wiring diagrams of control panel.

5. Power / Battery Calculations.
6. Submit shop drawing to local Code Official for review and approval prior to submission to Engineer for review.
   a. Shop drawings shall bear approval of authority or some other verification method to sustain review. If local authorities will not review.

7. Shop drawing shall also bear stamp of review by Electrical Contractor.
8. Manufacturer’s descriptive cutsheet of each initiation device, audible or visual signal and outlet box requirements for mounting. Provide symbol on cutsheet matching that shown on drawing for that device.

3.3 ATTIC STOCK:

A. Furnish as a part of the Fire Alarm System the following additional components. Components are for the purpose of providing:

1. Spares for Owner;
2. Supplementary devices to meet ambiguous Code requirements;

B. Requirement is to furnish device installed and connected to system and programmed to function with 30 feet of wire and conduit for connection to circuit.

   1. Pull Station 1 Quantity
   2. Ceiling-Mounted Smoke Detectors 1 Quantity
   3. Duct Detector 1 Quantity
   4. Wall-Mounted Strobe/Horn 0 Quantity
   5. Wall-Mounted Strobe/Speaker 1 Quantity
   6. Ceiling-Mounted Speaker 0 Quantity
   7. Monitor Module 1 Quantity

3.4 GENERAL REQUIREMENTS:

A. Furnish and install conduit, outlet boxes, back boxes, junction boxes, terminal cabinets, accessories, wiring connections, etc., required for a complete system as intended by these Specifications, and in accordance with the Manufacturer’s recommendation for the equipment supplied.

B. The conduit and wiring requirements shall be furnished by the Manufacturer’s Representative, and he shall, prior to bidding. Inform all Contractors of requirements which shall be included in the bid for this system.

C. All Fire Alarm wiring shall be run in conduit. Wall mounted devices shall be installed on outlet box with wiring in conduit, concealed in wall, and stubbed into ceiling.

D. All Fire Alarm conductors shall be #14 AWG minimum with type “XHHW”, “THWN”, or “THHN” insulation. Conductors shall be color coded in an approved manner. Each conductor shall be identified with T&B “E-Z” code markers at each device connection, each splice location, each junction box and terminal cabinet, and in the main control panel and remote annunciator.

E. Multiplex system wiring for Communication channels (2):

   1. Two (2) 2/C #18 twisted shield cable; Belden #8760, or as recommended by Manufacturer.

F. Provide Fire Alarm System junction boxes (“FJ”) as indicated. Junction boxes shall have painted red enamel covers with “FA” on small covers “FIRE ALARM” on large covers in 1 inch
high white letters. Splices in junction boxes made on identified terminal strips.

G. Provide terminal cabinets ("FT") where indicated, size as required, complete with identified terminal strips, quantity as required for number of wires entering cabinet. The cabinets shall be flush or surface mounted as indicated with full height piano hinged door with cylinder lock, keyed same as control panel. Finish shall be white enamel inside with red enamel outside. Install engraved plastic nameplate on cabinet door to identify cabinet as indicated in 1/4 inch high red letters on white background. Attach nameplate with two (2) small screws.

3.5 RECORD DRAWINGS:

A. The Contractor shall provide “Record Shop Drawings” at the completion of the job. The Electrical Contractor shall keep an accurate set of blue line prints on the job on which all changes from the Contract Drawings shall be indicated in red pencil on a day-to-day basis. At the completion of work, one (1) complete set of blue line prints will be furnished the Contractor by the Multiplex System Supplier for indication in red pencil the changes made in the actual installation. The actual location of all conduit systems, outlets, and equipment installed by this Contractor shall be indicated so as to enable the Owner to properly operate, maintain and repair both exposed and concealed work. These prints shall be turned over to the Architect at the Final Inspection. The work will be checked by the Architect’s or Engineer’s Representative using the “Record Shop Drawings”.

B. Contractor shall, at his expense, have corrections on “Record Shop Drawings” made to the original contract Shop Drawings by an approved professional draftsman. These “correct Shop Drawings” shall be turned over to the Architect.

C. Electrical Contractor shall furnish to the Architect three (3) bound sets of data, including approved corrected record Shop Drawings and Manufacturer’s complete operation and maintenance instructions for all equipment.

3.6 TESTING:

A. Complete system shall be tested in accordance with NFPA 72 to the Architect’s satisfaction. The tests shall include, but not be limited to, an operational test of each initiating and indicating device in the system, and verification of each device alarm zone. Manufacturer’s trained Technical Representative shall supervise installation, connections and test. Before acceptance, Manufacturer’s Representative will test and certify in writing that system is installed and functioning properly as intended by Drawings and Specifications. Test for photoelectric detectors to include sensitivity check with instrument and proper adjustment and/or replacement of defective detectors. Provide log of all test results. Furnish log on test showing each device tested.

B. Furnish eight (8) hours of instruction, to designated Owner’s Representative, on field programming.

C. Guarantee entire system in writing for one (1) year from date of acceptance by Owner. Guarantee will cover completely all components, equipment, wiring, etc. Repair any defects found in the system within the guarantee period without cost to Owner.

END OF SECTION
SECTION 16750 - TELEPHONE SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Telephone system consists of empty conduits, raceways, boxes, outlets, and terminal boards.

PART 2 – PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 TELEPHONE ENTRANCE:

A. Install entrance conduits as shown on drawings.

3.2 EMPTY CONDUIT:

A. Interior conduit EMT, minimum 3/4" unless noted otherwise. 2" size and larger - use screw indentor type fittings.

B. Conduit homeruns - minimum 1" unless otherwise noted.

C. Conduit to extend from wall and floor outlets and terminate with a bushing at backboard as shown on the plans.

D. All conduit shall have #14 iron fish wire or nylon pullcord.

3.3 TERMINAL BACKBOARD:

A. Terminal backboard constructed of high density, commercial grade pressboard, securely fastened to wall. Entire assembly painted with two coats of blue paint.

3.4 OUTLETS:

A. Provide outlets with blank device plate, except where telephone terminal is installed.

END OF SECTION
Trails of Africa
BIRMINGHAM ZOO

PROJECT OUTLINE SPECIFICATIONS

Divisions 0-16

ISSUE FOR BIDDING AND PERMIT
June 24, 2009

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