WDD ARCHITECTS
5050 NORTHSHORE LN
NORTH LITTLE ROCK, AR 72118

WDD ARCHITECTS

ENTRY HABITATS RENOVATION

LITTLE ROCK ZOO

CITY OF LITTLE ROCK

LITTLE ROCK, ARKANSAS

WDD PROJECT NO. 23-031

ISSUE SET

DECEMBER 20, 2024

WDD ARCHITECTS - ARCHITECTS | INTERIOR DESIGNERS | PLANNERS
5050 NORTHSHORE LN, NORTH LITTLE ROCK, ARKANSAS 72118
(501) 376-6681

TESSERE ARCHITECTS - ZOO CONTAINMENT & HABITATS
1525 E DOUGLAS AVE, WICHITA, KANSAS 72118
(316) 265-9367

Mechanical-Electrical Engineers
PETTIT & PETTIT CONSULTING ENGINEERS, INC.
201 E MARKHAM, STE 400, LITTLE ROCK, ARKANSAS 72201

Structural Engineers
ENGINEERING CONSULTANTS, INC.
401 W CAPITOL AVE, STE 305, LITTLE ROCK, ARKANSAS 72205

Civil Engineers
MCCLELLAND CONSULTING ENGINEERS, INC.
7302 KANIS RD, LITTLE ROCK, ARKANSAS 72204

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ENTRY HABITATS RENOVATION
CITY OF LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

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Invitation to Bid (ITB)

for

Little Rock Zoo – Front Entry Bond Project

City of Little Rock, Arkansas

This bid solicitation was issued by the City of Little Rock Procurement Division

Product or Service	**Little Rock Zoo – Front Entry Bond Project**		
Department	**Little Rock Zoo**		
Release to Prospective Vendors	**1/27/2025**	**Time**	**8:00 AM**
Proposal Due Date	**2/17/2025**	**Time**	**1:00 PM**
Deadline for Prospective Vendor Questions	**2/13/2025**	**Time**	**5:00 PM**
Pre-Bid Discussion Meeting	**MANDATORY – 2/3/2025 at 1:00P PM**		
Bid Opening Webex Meeting	**Join the meeting now**		

Procurement Website	Little Rock Business Portal | City of Little Rock

The City of Little Rock has issued this Invitation To Bid (ITB) to businesses authorized in the State of Arkansas and qualified to provide the requested service(s) outlined in this bid document.

The City of Little Rock actively supports small, minority and/or women-owned businesses to promote growth and sustainability.

Bidders must submit responses to this request online at LRProcure *powered by Bonfire* on or before the designated due date and time. Any responses received after this deadline will be considered late and returned to the Bidder without further review.

Responses should comply with all requirements stated in this bid request. If a conflict is found to apply to a key term (for example, quantity or type of work to be done) of this bid, the Bidder's response **shall** be disqualified at the City of Little Rock's sole discretion.

The City reserves the right to revise the ITB before the proposal submission deadline. If the City needs to make changes or revisions, an addendum will be posted on the Organization Portal. Only questions and answers in an addendum **shall** be considered part of the ITB.

The City has worked hard to make sure this request is correct, but it is up to you to check everything carefully because the City and its team are not responsible if there are mistakes or missing information. The responsibility for determining the full extent of the exposure to risk and verifying all information herein **shall** rest solely on those parties' making proposals. The City, its representatives, and

its agents **shall** not be responsible for any error or omission in this ITB, nor **shall** they be responsible for any Bidders or representatives' failure to verify the information herein and to determine the full extent of that exposure.

1. Background – City of Little Rock

Little Rock is the State Capital and the largest city in Arkansas. It was chartered in 1835 and is in the central part of the state, approximately 135 miles west of Memphis, Tennessee. The city has a population of 202,591 according to the 2020 census certified by the Arkansas State Treasurer. The 2025 operating budget revenues as approved by Ordinance No. 22079 are $338,231,579 including the General Fund revenue budget of $263,108,099.

2. Definitions

The City has made every effort to use industry-accepted terminology in this solicitation.

a) The words "**must**" and "**shall**" signify a requirement of this solicitation and that vendor's agreement to and compliance with that item is mandatory.

b) "Prospective Vendor" means a person who submits a bid in response to this solicitation.

c) "Vendor" means a person who sells or contracts to sell commodities and/or services.

d) "Responsive bid" means a bid submitted in response to this solicitation that conforms in all material respects to this ITB.

e) "Bid Submission Requirement" means a task a Prospective Vendor **must** complete when submitting a bid response. These requirements will be distinguished by using the term "**shall**" or "**must**" in the requirement.

f) "Requirement" means a specification that a vendor's product and/or service **must** perform during the term of the contract. These specifications will be distinguished by using the term "**shall**" or "**must**" in the requirement.

g) "City" means the City of Little Rock, Arkansas. When the term "City" is used herein to reference any obligation of the City under a contract that results from this solicitation.

3. Desired Outcome

3.1 The desired outcome of this ITB is professional completion of the Little Rock Zoo's Front Entry Bond Project, as indicated within this solicitation and all other supplementary documentation included

herein, provided by the Little Rock Zoo, or provided by its partners Alessi Keyes Construction and WD&D Architects.

4. Scope of Services

4.1 Goal

A. The Little Rock Zoo is seeking a qualified General Contractor to perform professional construction services for the 2025 Front Entry Bond Project.
   1. The awarded General Contractor **shall** work with the Little Rock Zoo, this project's Agency Construction Manager: Alessi Keyes Construction, and the Architect: WD&D Architects, through project completion.

4.2 Terms of Award

A. This bid **shall** be awarded, on an all or none basis, to the lowest responsive and qualified bidder who meets all specified requirements, and who has the absolute capability to provide the required services. Responses to this bid solicitation will be used by the City of Little Rock to determine if the vendor has the appropriate experience, licensures, and qualifications to be considered for the work.

B. The vendor must have a business license to operate in the State of Arkansas.

C. The City reserves the right to award or not award a contract, when in the best interest of the City to do so.

D. The term of this agreement will be for fourteen (14) months. Upon mutual agreement, the contract **may** be extended.

E. Bidder **must** provide a signed copy of the Combined Certification for Contracting with the City of Little Rock form prior to contract award.

4.3 Services Requested

A. All formal scope of service documents are hosted in Bonfire as supplementary documentation to this bid solicitation – noted as "**Full Construction Documents**" and "**Issue Set**"
B. All Issue Set documentation, scope, and plans in hard copy form are held at Southern Reprographics for purchase at standard cost.
   1. **The Tortoise exhibit and other corresponding aspects of that exhibit shall be noted as a deductive alternate in this bid.**

4.4 Minimum Qualifications

A. Statement of Vendor's Qualifications

   1. Vendors **must** submit a completed Statement of Vendor's Qualifications responding to ALL the questions. The responses provided **must** be clear and comprehensive. The statement **shall** be submitted in the form of a PDF attachment with your bid. The vendor **may** provide supplemental information, if deemed necessary.

B. Bid Bond

1. All city construction or demolition bids awarded that are **$50,000 or more require a Bid Bond** of 5.0 percent (%) of the total bid submission. This requirement can be satisfied by cashier's check drawn upon a bank or trust company doing business in this state of Arkansas, or by a corporate bid bond. Note: The bid bond is not required if less than $50,000.
   a. To be eligible, the cashier's check or bid bond **mus**t be received by the closing date and time for this bid solicitation to the following address:

      City of Little Rock
      Attention: Procurement Division
      500 West Markham Street, Suite 300
      Little Rock, Arkansas 72201

C. Bid Form

1. With bid submission, vendors **must** submit the Bid Form.
2. **Note: For bid to be considered for award, all addendums issued by the City of Little Rock pertaining to this bid solicitation must be recognized in writing on the Bid Form.**

D. Bid for Physical Improvements Form

1. With bid submission, vendors **must** submit the Bid For Physical Improvements Form.

E. List of Proposed Subcontractors

1. With bid submission, vendors **must** submit a list of proposed subcontractors

F. List of Proposed Suppliers

1. With bid submission, vendors **must** submit a list of proposed suppliers.

G. Certification of Current Arkansas State Contractor's License

1. Vendors **must** submit a clearly scanned copy of their current Arkansas State Contractor's License.
   a. Note: Contractors and subcontractors **shall** be licensed and bonded.

H. References

1. Vendors **must** submit a document displaying three (3) professional references and all applicable contact information for them.

I. Vendor **must** submit one (1) example of a project of similar size.

1. Due to the unique scope of this project, vendors **shall** provide one (1) example of a sizable project with similar scope, should it exist, else the City finds it amenable to review a project of similar size only.

4.5 General Requirements

A. **All vendors must attend the Mandatory Pre-Bid meeting on 2/3/2025 at 1:00P PM at the Little Rock Zoo Administration Building Conference room for their bid to be considered for award. Vendors must sign in with authorized Zoo staff. Staff can be reached at 501-661-7200 for any questions.**

B. Vendors **shall** be in agreement with and qualified to perform the work as outlined with all information present, or provided thereafter, within the Bid and Contract Documents (Little Rock Zoo – Front Entry Bond Project) and General Conditions sections of this solicitation.

C. All aspects of the project **must** meet current Federal ADA Regulations and Standards.

D. Vendors **shall** be in compliance with the requirement of Act 150 of 1965 of the State of Arkansas, effective June 3, 1965, (codified as amended at Ark. Code Ann. §§ 17-25-301 through 17-25-316), which is the current Arkansas State Licensing Law for Contractors. Vendors should indicate on the bid form the current license number as issued by the applicable licensing entity.

E. Bidder hereby agrees to commence work under this contract within **10 calendar days** after they receive the written "Notice to Proceed" of the City and to fully complete the Front Entry Bond Project within **425 consecutive calendar days (14 months)** thereafter as stipulated in the specifications.

   1. Bidder agrees to pay as liquidated damages, the sum of $550 for each consecutive calendar day thereafter as hereinafter provided in the special conditions.

F. It is expressly agreed that Contractor is acting as an independent contractor in performing the Work described herein.

G. Arkansas State Contractor License
   1. Bidders **must** provide a current copy of their Arkansas State Contractor License prior to contract award.
   2. *Note: Contractors and subcontractors **shall** be licensed and bonded.*

H. Prior to contract award, Contractor has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and laws and regulations that in any manner **may** affect cost, progress, performance or furnishing of the Work. The contractor agrees to comply with all applicable laws, statutes, regulations, ordinances, and permits relating to the performance of this contract.

I. Prior to contract award, Contractor has carefully studied all reports of explorations and tests of subsurface conditions and drawings of physical conditions and accepts the determination of the extent of the technical data contained in such reports and drawings upon which Contractor is entitled to rely.

J. Prior to contract award, Contractor has obtained and carefully studied, or assumes responsibility for obtaining and carefully studying, all such examinations, investigations, explorations, tests, reports and studies, in addition to or to supplement those referred to in paragraph 6.2 above, which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise that **may** affect the cost, progress, performance or furnishing of the Work

as Contractor considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Documents. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by Contractor for such purposes.

K. Prior to contract award, Contractor has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data with respect to said Underground Facilities are or will be required by Contractor in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents.

L. Prior to contract award, Contractor has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

M. Prior to contract award, Contractor has given Owner written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by Owner is acceptable to Contractor.

4.6 Insurance and Warranties

The vendor **shall** carry the following insurances throughout the term of the contract and any extension thereof. Prior to award of a resulting contract, the vendor **must** provide a Certificate of Insurance naming the City of Little Rock as additional insured.

Workmen's Compensation (statutory requirements)
Comprehensive General Liability – one million dollars ($1,000,000)
Personal Injury – one million dollars ($1,000,000)
Property Damage and other liabilities – one million dollars ($1,000,000)

4.7 Payment Structure

A. The vendor **shall** submit all invoicing resulting from contract purchase order to the City of Little Rock's **Accounts Payable Division**, Department of Finance, Room 315, 500 West Markham, Little Rock, AR 72201 at accountspayable@littlerock.gov. **Email invoice preferred**.

B. The contract price **may** be changed only by a Change Order. The value of any work covered by a Change Order or of any claim for increase or decrease in the contract price **shall** be determined by one or more of the following methods in the order of precedence listed below:

(A) Unit prices previously approved.

(B) An agreed lump sum.

4.8 Pricing

A. Any cost not identified by the successful vendor but subsequently incurred in order to achieve

successful operation **shall** be borne by the vendor.

B. To allow time to evaluate responses, prices **shall** be valid for ninety (90) days following the bid opening.

C. Pricing **shall** include all associated costs. The City **shall** not be obligated to pay any costs that are not included in the vendor's price proposal even though such cost is subsequently incurred by the vendor to provide the contracted services or equipment or to achieve the required quality of service unless agreed to in writing by the City.

D. The City should receive any discounts offered by, or available to the vendor. For term contracts the beginning date for computing discounts will be the date of invoice or the date of delivery and acceptance, whichever is later.

E. Prices quoted are to be net prices. If the vendor makes an error in extending total prices, the City **may** accept the lesser amount whether reflected by extension or by the correct multiple of the unit price.

F. The prices in the response have been arrived at without collusion.

G. All bid pricing **shall** be in United States dollars and cents.

5. Performance Metrics and Contract Management

5.1 The City seeks to collaborate with the Vendor and other stakeholders to enhance accountability and contract management, improve results, and adjust the delivery of products and/or services based on learning what works.

Metric	Data Source	Data Frequency	Responsibility	Review Cadence
1. On a linear scale from 1 to 5, how well coordinated and efficiently did the General Contractor work with the Agency Construction Manager?	Department Records	Completion of Contract	Little Rock Zoo	Monthly
2. On a linear scale from 1 to 5, how well coordinated and efficiently did the General Contractor work with the Architect?	Department Records	Completion of Contract	Little Rock Zoo	Monthly
3. On a linear scale from 1 to 5, how was the contractor's overall performance on the project?	Department Records	Completion of Contract	Little Rock Zoo	Monthly

4. Vendor Performance Report (Ad-hoc)	Vendor Performance Review Form	As Needed – At Least Once Per Contract	City of Little Rock Procurement Division	Completion of Contract
5. Vendor Performance Review	Bonfire	Annually	City of Little Rock Procurement Division	Annually

5.2 Contract Management

A. Communication Plan

1. To manage this contract and the goals outlined in sections herein, the City will collect performance data and regularly discuss with the selected vendors the performance metrics.

2. The monthly update meeting **shall** occur at an agreed-upon time and date each month. Upon mutual agreement, the parties **may** move this meeting if necessary to avoid scheduling conflicts, holidays, or similar occurrences. Any changes or cancellations to a meeting **shall** be communicated at least twenty-four (24) hours in advance.

5.3 Joint Ventures

A. A joint proposal submitted by two or more vendors is acceptable.

1. In the event of a joint venture, documentation **must** be submitted with the proposals identifying all participating business entities.

2. Prior to award, a binding agreement between the participants **must** be provided. The City will recognize both companies as one entity.

3. The City **shall** have a single point of operational contact with the entity that is formed pursuant to this provision.

4. Two companies with the same physical address or with a single point of operational contact will be considered one entity.

5. In efforts to meet the Mayor's Initiative to increase spend, it is highly recommended that any joint ventures include small, minority and/or women-owned businesses.

6. Contract

6.1 Issuance of Contract.

A. Any resultant contract of this bid solicitation is subject to City approval processes which **may** include board review.

6.2 Cooperative Use

A. The City of Little Rock, as the issuing office for this solicitation, **shall** be the lead agency for this contract. Other governmental entities **may** participate in any contract resulting from this solicitation that falls under its scope of work throughout the life of the contract.

B. The vendor **shall** agree to offer the same pricing, terms, and conditions to participating governmental entities as outlined in this solicitation.

C. There is no obligation for any agency to purchase from the awarded contractor, nor does it guarantee any additional orders will result. However, it does allow entities at their discretion, to make use of the City of Little Rock's competitive procurement process directly from the awarded contractor. All purchases made **shall** be understood to be transactions between that entity and the awarded vendor.

6.3 The City of Little Rock **shall** not assume liability or obligation on behalf of any other governmental entity that **may** use any contract resulting from this solicitation. All purchases and payment transactions **shall** be made directly between the vendor and the requesting entity.

7. Inquiries and Submission Instructions

7.1 The responsive bid **must** be submitted through online bidding at **LRProcure** *powered by Bonfire*.

7.2 For any system-related questions, technical errors or help, please contact Bonfire Technical Support or using the Help Button or at **support@gobonfire.com** Mon-Fri 8:00am-8:00pm EST.

7.3 For all other assistance, staff is available at (501) 371-4560. Bidder acknowledges that support **may** not be readily available the day of or the hours/minutes prior to a bid closing date/time.

7.4 All responsive bids will be subject to public information pursuant to the Arkansas Freedom of Information Act.

Opening Bid Webex Meeting link:
https://teams.microsoft.com/l/meetup-join/19%3ameeting_OTA2OTgxOTYtYzg2Zi00YzcwLWIwNTYtMjE0NTNhMTg1OWIw%40thread.v2/0?context=%7b%22Tid%22%3a%2284d336e2-3cb3-4ee8-91ca-5e4f107776ce%22%2c%22Oid%22%3a%22b1a90390-007b-450f-8db2-5551af7b7b27%22%7d

Meeting ID: 219 782 793 622

Passcode: Uq6cb69Z

Dial in by phone

+1 972-371-0918,,402426105# United States, Dallas

Find a local number

Phone conference ID: 402 426 105#

At the above-noted date and time, Bidders that have submitted proposals will have their names read aloud publicly during a virtual bid meeting and those names will become public information.

8. Supplemental Documentation for Vendors

8.1 Pertinent supplemental documentation is available on the bid event in Bonfire.

8.2 Architectural plans, drawings and the plan-holder's list are available for the standard fee(s) in hard-copy form at Southern Reprographics; 901 W 7th St, Little Rock, AR 72201.

8.3 City of Little Rock Ordinance 20,482 § 1, 10-3-11, Sections 18.51 – 18.53: https://library.municode.com/ar/little_rock/codes/code_of_ordinances?nodeId=COOR_CH18MIPROF_ARTIIOFINPUPEOR

8.4 Act 1068 – "To Repeal The Arkansas Prevailing Wage Law; And To Provide Flexibility To Cities And Counties For Capital Construction Projects; And To Declare An Emergency: https://www.arkleg.state.ar.us/Bills/Detail?ddBienniumSession=2017%2F2017R&measureno=sb601

9. Terms and Conditions

All prospective Vendors who submit a proposal agree to be bound by the City of Little Rock **Standard Terms and Conditions** for Bidders and the online *Bonfire Terms & Conditions*.

PART 1 - GENERAL

1.01 DESCRIPTION OF BID

A. Base Bid: Work includes Site Preparation and Improvements, General Construction, Mechanical Work and Electrical Work, as shown on the Drawings and described herein, all to be let under one prime contract.

B. Bid Documents: Bidders, sub-bidders, material suppliers and other interested parties are encouraged to obtain complete sets of Bid Documents from the Architect. Complete sets of Bid Documents should always be used in preparing bids. Neither the Owner nor Architect assumes responsibility for errors in bidding or misinterpretations of Bid Documents resulting from the use of incomplete sets of Bid Documents. The documents obtained through the Architect are considered the official version and take precedence if any discrepancies occur. The use of incomplete or inaccurate Bid Documents does not relieve the bidder of the obligation to perform all work related to his bid as detailed in a complete set of Bid Documents.

1.02 EXAMINATION OF PREMISES

A. Before submitting his bid, Contractor will be held to have examined the premises and satisfied himself as to existing conditions under which he will be obligated to operate, or that will in any manner affect Work under this contract.

B. Bidder must inform himself fully of conditions relating to construction of project and employment of labor. Failure to do so does not relieve successful bidder of his obligation to furnish material and labor necessary to carry out provisions of his contract. Insofar as possible Contractor, in carrying out his Work, must employ such methods or means to avoid any interruption of or interference with Work of any other Contract.

1.03 CONTRACTOR'S LICENSE

A. Parties bidding on this Work must comply with all requirements and regulations of Contractor's License Law of the State of Arkansas, as set forth in Arkansas Code Annotated § 17-25-101 et. seq..

1.04 BID FORMS

A. Bids must be submitted on forms included in Document 00 41 13 of Project Manual. Submit one copy.

B. Place Bid Documents in a sealed envelope and clearly label with words **"Bid Documents"**. Show job name and number, name of bidder, Contractor's License Number, date and time of opening.

C. Attention of Bidders is called to Section 01 23 00-Alternates in Division 1 - General Requirements of this Project Manual which will affect the manner of completion of the Bid Form.

D. In case of discrepancy between written amounts shown by bidder and amounts in numerical figures on bid form, the amount written out rather than amount in numerical figures shall govern.

1.05 INTERPRETATIONS

A. No interpretation of plans, specifications or other bid documents will be made orally to any bidder. Requests for interpretation or clarification of Bid Documents must be made in writing addressed to **Wittenberg, Delony & Davidson, Inc.,**
ATTN: Gordon Duckworth, AIA, duck@wddarchitects.com.

1. **TO BE GIVEN CONSIDERATION, REQUESTS FOR INTERPRETATION MUST BE RECEIVED AT LEAST FIVE (5) WORKING DAYS PRIOR TO DATE FIXED FOR OPENING OF BIDS.**

B. Interpretations and supplemental information will be issued in the form of written addenda issued to prospective prime contract bidders. **ADDENDA WILL NOT BE ISSUED WITHIN THREE (3) WORKING DAYS (72 hours) PRIOR TO DATE FIXED FOR OPENING OF BIDS.** Failure of bidder to receive any addendum shall not relieve bidder from obligation under his bid as submitted. All addenda so issued shall become part of Contract Documents.

C. Should an error, inconsistency or omission be found in the Bid Documents after the Bid Opening, the Contractor will be deemed to have prepared his bid based upon the more costly or complex way of performing the Work or in accordance with the more stringent requirements.

D. Anything mentioned in the Specifications and not shown on the Drawings or shown on the Drawings and not mentioned in the Specifications is to have the same effect as if shown or mentioned in both.

E. Precedence **IS NOT** given to the Specifications over the Drawings or to Large Scale Drawings over Smaller Scale Drawings. All drawings and all specifications are complimentary and shall be viewed collectively when interpreting the Design Intent for the Project. The Architect is the sole judge and interpreter of Design Intent and his decision will be final and binding upon the General Contractor.

1.06 BID GUARANTY

A. Bid must be accompanied by bid guaranty of not less than five percent (5%) of the amount of bid, and at option of bidder may be cashiers check or bid bond secured by surety company and made payable to order of Owner. Bid guaranty shall insure execution of contract and furnishing of performance and payment bond or bonds by successful bidder.

1. If a Bid Bond is provided, the Bond must be signed by an authorized agent of the Bonding Company and the agent's power of attorney must be submitted with the Bid Bond.

1.07 OPENING OF BIDS

A. At time and place fixed for opening of bids, every bid received within time fixed for receiving bids will be opened and publicly read aloud, unless the bid contains irregularities in statutory requirements. Failure of bidder to respond to statutory requirements listed on the bid form may result in the bid being declared non-responsive and the bid will not be read nor will the bid be considered for the purposes of awarding a Contract.

1.08 WITHDRAWAL OF BIDS PRIOR TO BID OPENING

A. Bids may be withdrawn on written or electronic request dispatched by bidder in time for delivery in normal course of business prior to time fixed for opening; provided, that written confirmation of any electronic withdrawal over signature of bidder is placed in the mail and postmarked prior to time set for bid opening. Negligence on the part of bidder in preparing his bid confers no right of withdrawal or modification of his bid after such bid has been opened.

1.09 QUALIFICATIONS OF BIDDER

A. Owner may make such investigations as he deems necessary to determine ability of bidder to perform Work, and bidder shall furnish to Owner all such information and data for this purpose Owner may request. Owner reserves right to reject bid of any bidder who has previously failed to perform properly, or to complete on time, contracts of similar nature; who is not in position to perform contract, or who has habitually and without just cause neglected payment of bills or otherwise disregarded obligations to subcontractors, materialmen, or employees.

1.10 POWER OF ATTORNEY

A. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

1.11 LAWS AND REGULATIONS

A. Bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and rules and regulations of authorities having jurisdiction over construction of project shall apply to contract throughout, and they will be deemed to be included in contract the same as though written out in full.

1.12 BID FORMALITIES AND REJECTION OF BIDS

A. Owner reserves right to waive any formalities in a bid or to reject any or all bids.

1.13 CONDITIONAL BIDS

A. Conditional bids will not be considered.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 21 13

PART 1 - GENERAL

1.01 SOILS REPORT

A. A geotechnical investigation of the site has been made for use in site grading and foundation design for this Project. This report has been bound herein for information purposes only. Boring logs and test data are for information only. Conditions are not intended as representations or warranties of accuracy or continuity between each soil boring. Architect and Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor and advise Contractor to make his own investigations as he deems necessary.

B. Additional boring tests and other exploratory operations may be performed by Contractor, at the Contractor's expense; however, no change in the Contract Sum will be authorized for such additional exploration.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 31 32

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December 19, 2024
Job No. A24184.00500

WDD Architects
5050 NorthShore Lane
North Little Rock, Arkansas 72118

Attn: Mr. Wallie G. Sprick, AIA
Executive Vice President | COO

REF: GEOTECHNICAL RECOMMENDATIONS
LITTLE ROCK ZOO ENTRY HABITATS RENOVATION
LITTLE ROCK, ARKANSAS

INTRODUCTION

Submitted herewith are geotechnical recommendations related to design and construction of the Little Rock Zoo Entry Habitats Renovation project in Little Rock, Arkansas. These services were authorized on behalf of WDD Architects by Mr. Sprick on November 14, 2024. The scope of work has been in general accordance with our proposal of November 12, 2024 (GHBW Proposal No. A24184.00500). Because the Little Rock Zoo is presently an active facility with significant conflicts between new project feature locations and existing features, no field work could be performed at this time. Consequently, drilling and sampling and laboratory testing of representative soil and rock samples were not included in the scope of this study. To develop information on subsurface conditions, we have relied on information developed from prior geotechnical studies in the area and our experience working in the general vicinity, including previous projects at the Little Rock Zoo, War Memorial Stadium, the Arkansas Department of Health facility, and the University of Arkansas for Medical Sciences, as well as others in the immediate area. Site conditions were evaluated by the observations of a recent site visit. Project information was provided by the Architect, WDD Architects, and the Structural Engineer, Engineering Consultants.

We understand that the Entry Habitats Renovation project will include multiple structures as well as demolition of existing facilities, and site improvements with re-grading and new walkways. It is understood that the new structures include the following.

- Animal Care Building
- Lemur Building
- MEWS Building
- Tortoise Building
- Ambassador Cages
- Miscellaneous storage buildings, paths, and landscape features.

The new buildings are expected to utilize block construction and to have light foundation loads. Site preparation will include substantial demolition and site grading is expected to include both cut and fill. A site plan and demolition plan detailing the proposed zoo entry habitats renovation is provided in Attachment 1.

SITE and SUBSURFACE CONDITIONS

Site Conditions

The proposed renovations are focused on the walkways and habitats near the main entrance of the Little Rock Zoo. The project area is a mix of concrete walkways, landscaping including areas of grass, shrub and trees with numerous walkways, and small buildings which include both facilities for visitors and zoo staff, and animal habitats. Some of the habitats are artificial islands surrounded by below-grade moats. In some areas, underground tunnels extend to and from existing habitats. Vertical relief is extensive across the site, with the topography generally falling to the south. The exception to the sloping terrain is the area near the existing greenhouse which is mostly flat. Site grades are frequently transitioned by retaining walls. The south part of the project area is bordered by a large retaining wall which has been rendered as a cliff face for the current primate habitats. Surface drainage is considered fair, in large part due to the sloping terrain and the numerous paved areas.

Site Geology

Geologically, the Little Rock Zoo site is located in the mapped outcrop of the Pennsylvanian Period Jackfork Sandstone formation. The Jackfork Sandstone formation is comprised of thin- to massive-bedded fine- to coarse-grained quartzitic sandstone with subordinate units of silty sandstone and shale. The sandstone sometimes occurs as discontinuous masses in the shale. The shale and sandstone units are typically moderately dipping to steep and quartz veins and inclusions are relatively common. The thickness of the formation varies from 3500 to 6000 feet. The Jackfork Sandstone rests conformably on the Stanley Shale.

Seismic Conditions

The Little Rock Zoo in Pulaski County, Arkansas site is located in Seismic Zone 1, defined by the Arkansas Building Authority (2005) as the zone of least seismic potential. In light of the results of the borings performed at the zoo facility and nearby locations, a Seismic Site Class C (very dense soil and soft rock profile) is considered suitable for the site in accordance with the criteria of the Arkansas Fire Prevention Code Vol II and the International Building Code (IBC 2021) and ASCE 7, Chapter 20.IBC 2021. The liquefaction potential this site is considered low to negligible for the predominantly cohesive overburden soils weathered rock.

Subsurface Conditions

As noted, the site was not accessible to drilling equipment. Consequently, our prior experience and the results of prior geotechnical studies have been utilized to develop general information on anticipated subsurface conditions at the Little Rock Zoo site. Specifically, information developed from geotechnical studies in the immediate project area were utilized to develop geotechnical recommendations for this project. These studies included:

- Little Rock Zoo Big Cat Exhibits; McClelland Engineers, Inc. Report No. LR80-293, dated November 6, 1980 with a supplement dated December 8, 1980.
- War Memorial Park Complex; Anderson Engineering Consultants, Inc. Job No. 1083 dated September 18, 1989.
- Stadium Seating – War Memorial Stadium, Grubbs, Hoskyn, Barton & Wyatt, Inc. Report No. 99-030 dated February 11, 1999.

A plan showing the sources of geotechnical information and relative locations with respect to the Little Rock Zoo Entry project is provided in Attachment 2. Relevant boring logs from the referenced nearby sites are provided in Attachment 3.

In light of the available subsurface information, our site observations of November 2024, and our experience in the area, the overburden soils are anticipated to be a variable mixture of silty clay, shaly clay, and clay with localized and subsidiary units of clayey silt and silt. The clayey silt and silt units are likely to be at shallow depth, if present. Clayey overburden soils are anticipated to have variable low to moderate shear strength and moderate compressibility. Some clay units with medium to high plasticity could also be present. The medium- to high-plasticity clay is expected to have some potential for shrink swell activity.

Given the widely variable site terrain and the lengthy history of prior development in the project area, on-site fill is expected to be present. Fill thickness, compaction and content may vary widely. Some relatively deep zones of debris-laden fill could be locally present. In addition, a surface zone of organic topsoil could have a wide range in layer thickness.

Below about 2- to 12-ft depth is low hardness to hard weathered shale to fresh shale and sandstone. The shale has low compressibility and high shear strength and generally increases in competence with depth. Shallow intervals of low hardness to moderately hard weathered shale are expected to classify as soft rock. The weathered shale in this area is typically steeply to very steeply dipping and exhibits differential weathering. Variable sandstone seams and layers are often interbedded with the shale. The sandstone contains quartz partings and seams and is generally strong, well cemented, and competent. The quartzitic sandstone units may classify as very hard rock. Auger refusal, indicative of hard rock, was locally encountered in nearby borings at 6- to 8-ft depth. It has been our experience that hard rock units can occur at variable depths.

Shallow groundwater was not encountered within the depths of the borings drilled in October 1980 and August 1989. Shallow groundwater was encountered in the War Memorial Stadium borings in February 1999. This is believed to represent shallow perched water accumulated in the overburden soils above the shale and sandstone units. Shallow perched water is likely to be present in the silty overburden soils, beneath existing pavements and foundation elements, and in fractured rock zones in the Entry project area. Shallow groundwater levels will be influenced by seasonal precipitation and surface infiltration and runoff and should be expected to vary with seasonal precipitation and ongoing grading operations.

CONCLUSIONS and RECOMMENDATIONS

Foundation Design

Foundations for the habitats renovation project must satisfy two (2) basic and independent design criteria. First, the maximum bearing pressure must not exceed the allowable bearing pressure based on an adequate factor of safety with respect to shear strength. Secondly, foundation movements resulting from consolidation, shrinking, or swelling of the supporting soils must be within tolerable limits for the structure. Construction factors such as foundation construction, excavation procedures, and surface and groundwater conditions must also be considered.

In light of the anticipated subsurface conditions and the expected light foundation loads of the new buildings and units, footing foundation systems are recommended for support of structural loads. However, special consideration must be given to field verification of the specific bearing stratum and to confirmation of suitable bearing capacity. Some undercut and replacement with select fill is likely to be required for foundation and floor slab construction, particularly following existing slab and foundation demolition and during wet seasons. Recommendations for footings and floor slabs are discussed in the following report sections.

Footings

We recommend that foundation loads of the new buildings and habitats be supported on continuous or individual footings founded in the natural stiff to very stiff silty clay or shaly clay, low hardness to moderately hard weathered shale, competent sandstone, or in compacted select fill. The suitability of the footing bottom bearing stratum must be field verified by the Geotechnical Engineer at the time of construction. Localized undercuts will likely be warranted to develop suitable bearing for foundation elements, depending on specific site conditions. In addition, where a highly-plastic clay (i.e., plasticity index greater than 25) bearing stratum is encountered, footings should be undercut at least 2 ft below the plan footing bottom elevation.

Where footing undercuts are required, the undercuts should extend to the suitable natural bearing stratum as recommended above and field verified by the Geotechnical Engineer to be suitable for bearing. Footing undercuts should have a minimum width determined by a 1-horizontal to 2-vertical (1H:2V) projection from the foundation edge to the required undercut depth. Undercuts may be excavated neat to plan footing dimensions where backfilled with flowable fill or concrete. If footings are closer than 1H:2V to existing walls, lateral surcharge loads on existing walls must also be considered. Where mass undercuts are required by site conditions, foundation elements may be supported in the undercut backfill. Mass undercuts should extend at least 5 ft outside the building limits to the extent possible.

Footings founded as recommended may be sized based on maximum net allowable soil bearing pressures of 1500 lbs per sq ft for continuous and individual footings. The recommended bearing values include a minimum factor of safety of 2.5 with respect to the anticipated shear strength of stiff silty clay or shaly clay and anticipated shear strength of properly compacted select fill. Post-construction settlement of foundations supported as recommended and underlain by less than 6 ft of compacted fill should be less than 1.0 inch. Differential settlement should be less than about one-half of the total settlement value.

Where compacted fill thickness below footings is in excess of 6 ft or below floor slabs is in excess of 8 ft, special consideration must be given to the differential settlement potential. This situation should be evaluated by the Geotechnical Engineer on a case-by-case basis.

Uplift resistance of footings will be provided by the weight of the structure and the foundation units. Resistance to lateral forces will be developed by the passive resistance of the foundation soils and sliding resistance at the footing bottom. The passive resistance of the soil within the upper 2 ft should be neglected. Below 2-ft depth, an ultimate passive resistance value

of 250 lbs per sq ft may be assumed for the stable on-site soils and compacted fill. Resistance to sliding may also be evaluated using an ultimate friction value (tan δ) of 0.33 for concrete on the recommended bearing strata. An appropriate factor of safety must be included in the sliding analysis.

Continuous footings should have a minimum width of 18 in. and individual footings should have a minimum dimension of 24 inches. Perimeter footings and footings in unheated areas should extend a minimum of 1.5 ft below final grade for embedment and frost protection. Interior footings or thickened sections in structures with interior heating can be founded in suitable bearing strata or compacted select fill at shallower depths consistent with structural requirements for thickness. The Geotechnical Engineer must observe all footing excavations and any foundation undercuts to verify suitable bearing.

Floor Slabs

Slab-on-grade construction is recommended for building and habitat floor slabs. Subgrade preparation must include thorough proof-rolling to verify subgrade stability. Based on local experience and depending on final grading plans, seasonal site conditions, and conditions after final demolition operations, undercuts on the order of 2 to 4 ft, more or less, could be warranted. This undercut depth is an estimate only and variations in undercut depths should be expected. Where highly-plastic clay with a PI in excess of 25 is encountered at the slab subgrade elevation, it should be undercut at least 2 ft below plan grade. The undercut depth and bottom stability should be field verified by the Geotechnical Engineer.

We also recommend that floor slabs be supported on a 4- to 6-in.-thick clean crushed stone layer placed on a properly prepared subgrade. The granular layer should be densified with vibrating equipment prior to floor slab construction. Impervious sheeting should be placed between the slab and granular course to act as a vapor retarder. Post-construction settlement of floor slabs supported as recommended and underlain by less than 8 ft of compacted fill should be less than 1.0 inch.

Site Grading

Site preparation is expected to include stripping the organic surface soils in landscaped areas and demolition of the existing pavements, floor slabs, and foundations. Some existing moats and tunnels are included in the demolition plan. The depth of stripping in landscaped areas is estimated to be about 6 to 12 inches. Deeper stripping may be required in areas of thick shrubbery or heavy landscaping. All abandoned underground tunnels, utilities, and foundations in the

building or habitat areas should be fully excavated and backfilled with select fill unless specifically accepted by the Architect.

After required demolition, stripping, and performing any cut, the subgrade should be proof-rolled with a loaded tandem-wheel dump truck or similar equipment. Areas identified to be soft or that exhibit pumping should be undercut and processed and re-compacted or replaced, whichever is appropriate. Depending on specific seasonal site conditions and final grading plans, undercuts of 2 to 4 ft, more or less, below existing grade may be warranted. Building undercuts should extend at least 5 ft outside building limits to the extent possible.

The on-site silty clay and shaly clay may be considered for use as select fill or backfill use in structure or flatwork areas. However, suitability of these should be confirmed by suitable classification testing and verified acceptable by Geotechnical Engineer. The weathered shale with a plasticity index (PI) of 18 or less is suitable for select fill use structure areas. The weathered shale should be processed to a reasonably well-graded mixture with a top size of about 3 inches. Imported borrow for fill or backfill should consist of an approved silty clay and shale fragment blend or an approved low-plasticity clayey sand (SC), sandy clay (CL), or clayey gravel (GC) with a liquid limit less than 45 and a maximum plasticity index (PI) of 18 or approved alternates. We recommend that trenches under walks, roads, and drives be backfilled with crushed stone aggregate base (ARDOT Class 7). All fill and backfill should be approved by the Geotechnical Engineer.

The project will include demolition of on-site buildings, walls, and pavements. Crushed concrete may be considered for use as structural fill. Crushed Portland cement concrete used for fill or backfill should be free of all reinforcing steel and deleterious materials and thoroughly blended and processed to a reasonably well-graded mixture with a maximum particle size of 2 inches. Use of crushed concrete can be considered at the base of deep fills to reduce differential settlement in such areas.

Fill, backfill, and recompacted soils should be compacted to at least 95 percent of the Modified Proctor (ASTM D1557) maximum dry density. Low-plasticity soils (clayey sand, sandy clay, or clayey gravel) should be compacted within a water content range of 2 percent below to 3 percent above the optimum value. Shale fragment blends should be watered as necessary to obtain a water content ranging from optimum to 3 percent above optimum during compaction. If a silty clay-shale fragment blend fill is used, particular attention should be given to compaction and placement procedures. Fill and backfill should be placed in horizontal, nominal 6- to 8-in.-thick

lifts. Each lift of fill or backfill should be properly compacted, tested and approved prior to placing subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Shallow groundwater could be present during construction, particularly around abandoned foundation elements and underground utilities. Limited seepage into shallow excavations can probably be controlled by ditching or via sump-and-pump methods. If seepage infiltration cannot be controlled, construction of drains and/or the use of stone backfill (i.e., #57 stone or approved alternate) will be warranted. Clean stone backfill should be fully encapsulated in geotextile filter fabric and vented to positive discharge into storm lines or to daylight.

All foundation excavations and undercuts must be observed by the Engineer and Geotechnical Engineer to verify suitable bearing. Concrete should be placed in foundation excavations expeditiously following final clean up and approval to limit changes in foundation conditions. Foundation excavations should be clean and dry at the time of concrete placement. Where foundation excavations will be left open for extended periods, the bearing stratum should be protected with a thin layer of seal concrete.

Our experience in the area has been that hard rock may be encountered at shallow depths. The potential for rock excavation should be anticipated. Contract documents should include a unit price for removal and disposal of materials and obstructions that cannot be excavated with conventional heavy-duty excavating equipment. The conventional heavy-duty excavating equipment may be defined as a Caterpillar D-7 bulldozer with single tooth ripper, a Caterpillar 312B track excavator equipped with rock teeth, or equipment of similar power and capability. Rock excavation volumes should be determined based on in-place measurements via cross sectioning. If excavation is to be unclassified, the Contractor must be responsible for assessing rock excavation requirements.

CLOSURE

The conclusions and recommendations discussed herein have been based on our experience in the area, the anticipated subsurface conditions on the subject site, our site observations, and our understanding of the project. Some variations in the subsurface conditions described herein are likely. This report does not constitute a warranty or guarantee of subsurface conditions or foundation conditions at the Zoo Entry Habitats Renovation location, neither expressed nor implied. Suitability of the recommendations provided herein must be field verified. Depending on specific foundation

and/or subgrade conditions encountered during construction, modification of the recommendations provided herein are likely to be warranted.

The following attachments are included and complete this submittal.

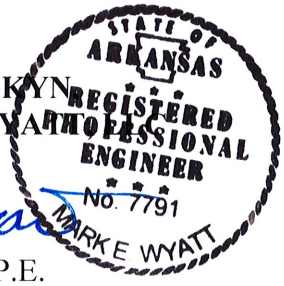
Attachment 1	Habitats Renovation Site and Demolition Plans
Attachment 2	Sources of Subsurface Information
Attachment 3	Plan of Borings and Relevant Boring Logs

* * * * *

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or when we may be of additional assistance during final design or construction, please call on us.

Sincerely,

GRUBBS, HOSKYN, BARTON & WYATT



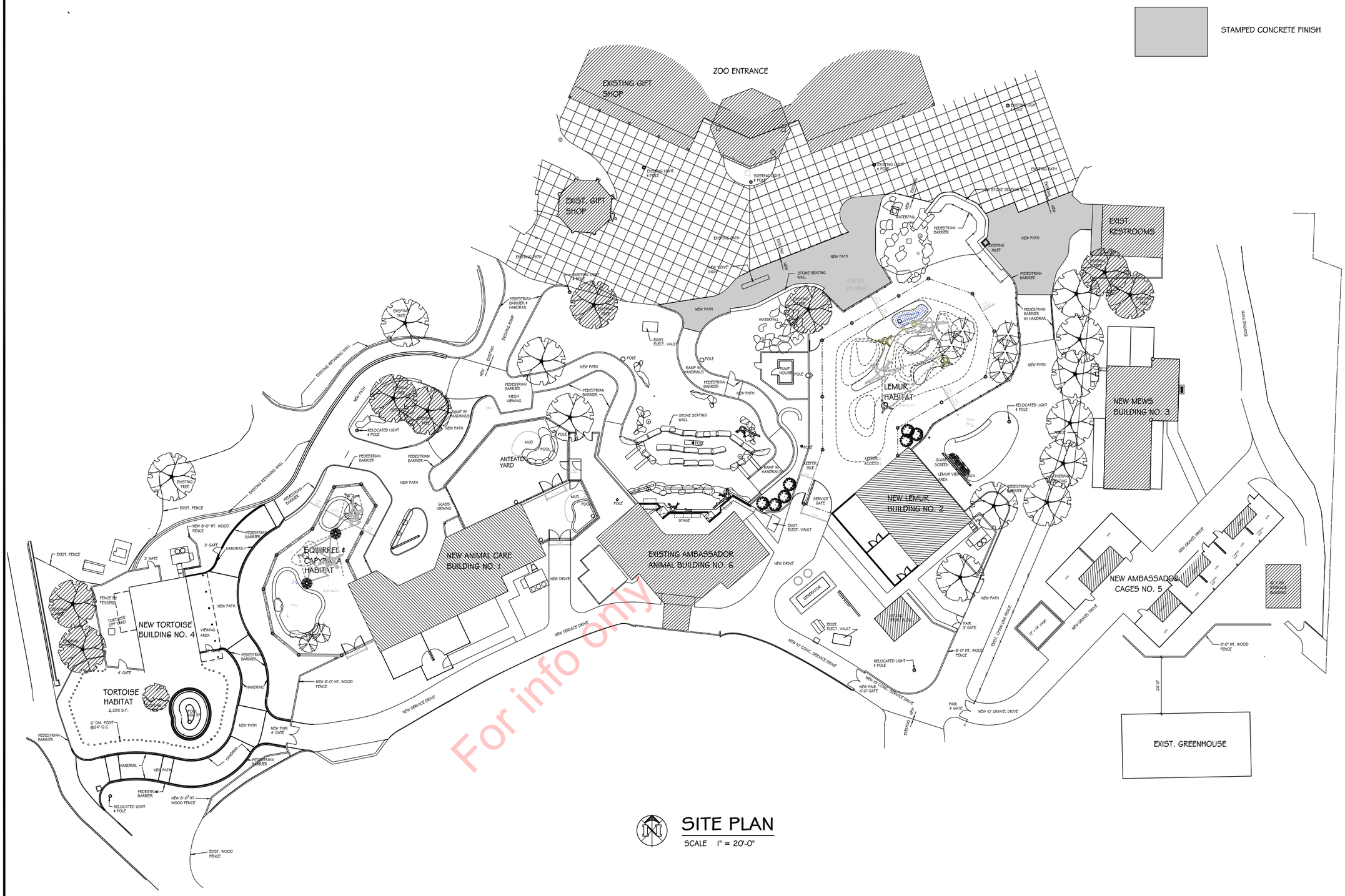
Mark E. Wyatt, P.E.
President

JKB/MEW:jw

Copies submitted: WDD Architects
Attn: Mr. Wallie G. Sprick, AIA (1-email)
Attn: Mr. Steve Moss, AIA (1-email)
Attn: Mr. Gordon Duckworth, AIA (1-email)

Engineering Consultants, Inc.
Attn: Mr. Ritchie Brown, P.E. (1-email)

ATTACHMENT 1



SITE PLAN

SCALE 1" = 20'-0"

Recieved 10-31-2024

WDD ARCHITECTS

PROJECT TITLE

LITTLE ROCK ZOO

ENTRY HABITATS RENOVATION

1 ZOO DRIVE, LITTLE ROCK, ARKANSAS

CONTENTS

SITE PLAN

REVISIONS

NO.	DATE	DESCRIPTION
	6/25/24	REVISED SITE PLAN

DATE

23-031

8-16-24

50% Construction Documents

SHEET

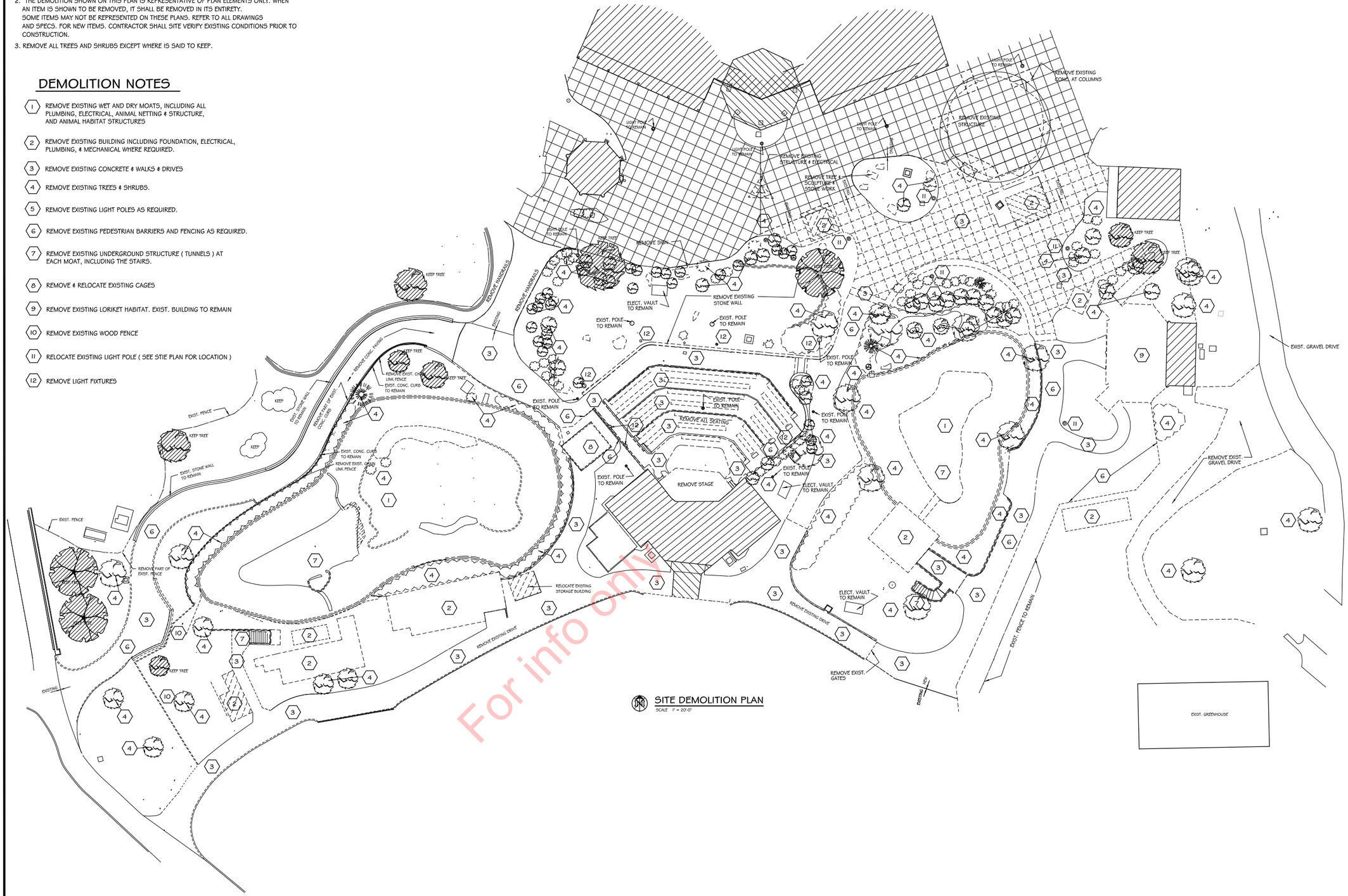
A0.1

DEMOLITION GENERAL NOTES

1. DASHED LINES INDICATE EXISTING ITEMS TO BE REMOVED.
2. THE DEMOLITION SHOWN ON THIS PLAN IS REPRESENTATIVE OF PLAN ELEMENTS ONLY. WHEN AN ITEM IS SHOWN TO BE REMOVED, IT SHALL BE REMOVED IN ITS ENTIRETY. SOME ITEMS MAY NOT BE REPRESENTED ON THESE PLANS. REFER TO ALL DRAWINGS AND SPECS. FOR NEW ITEMS. CONTRACTOR SHALL SITE VERIFY EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
3. REMOVE ALL TREES AND SHRUBS EXCEPT WHERE IS SAID TO KEEP.

DEMOLITION NOTES

1. REMOVE EXISTING WET AND DRY MOATS, INCLUDING ALL PLUMBING, ELECTRICAL, ANIMAL NETTING & STRUCTURE, AND ANIMAL HABITAT STRUCTURES
2. REMOVE EXISTING BUILDING INCLUDING FOUNDATION, ELECTRICAL, PLUMBING, & MECHANICAL WHERE REQUIRED.
3. REMOVE EXISTING CONCRETE & WALKS & DRIVES
4. REMOVE EXISTING TREES & SHRUBS.
5. REMOVE EXISTING LIGHT POLES AS REQUIRED.
6. REMOVE EXISTING PEDESTRIAN BARRIERS AND FENCING AS REQUIRED.
7. REMOVE EXISTING UNDERGROUND STRUCTURE (TUNNELS) AT EACH MOAT, INCLUDING THE STAIRS.
8. REMOVE & RELOCATE EXISTING CAGES
9. REMOVE EXISTING LORIKET HABITAT. EXIST. BUILDING TO REMAIN
10. REMOVE EXISTING WOOD FENCE
11. RELOCATE EXISTING LIGHT POLE (SEE STIE PLAN FOR LOCATION)
12. REMOVE LIGHT FIXTURES



SITE DEMOLITION PLAN
SCALE 1" = 20'-0"

WDD ARCHITECTS

PROJECT TITLE
LITTLE ROCK ZOO
ENTRY HABITATS RENOVATION
1 ZOO DRIVE, LITTLE ROCK, ARKANSAS

CONTENTS
SITE DEMOLITION PLAN

REVISIONS

NO.	DATE	DESCRIPTION

SHEET DATE
23-031
8-16-24
50% Construction Documents

D0.1

ATTACHMENT 2

For Information Only

Approx. 1000 ft North

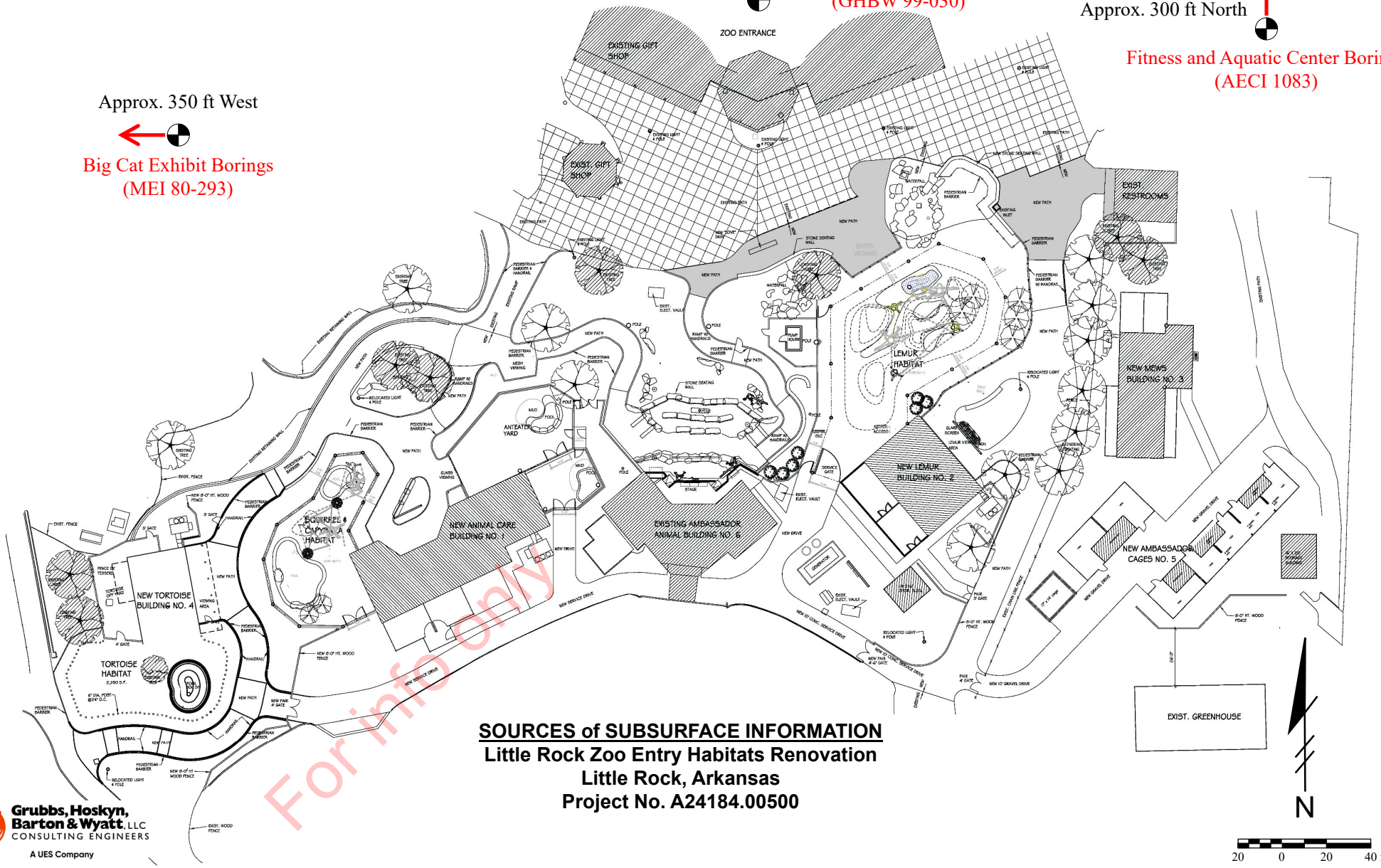
War Memorial Stadium Borings
(GHBW 99-030)

Approx. 300 ft North

Fitness and Aquatic Center Borings
(AECI 1083)

Approx. 350 ft West

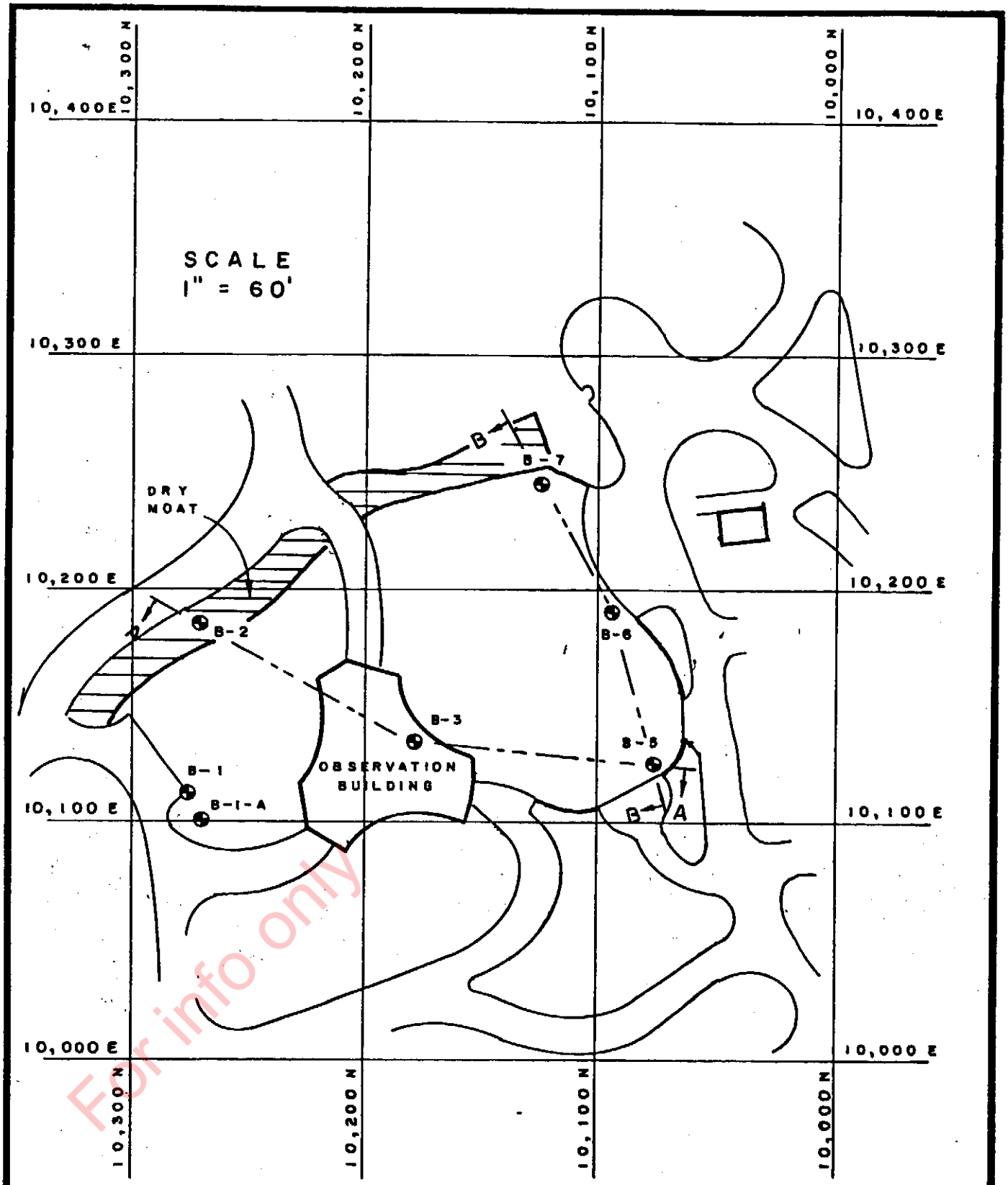
Big Cat Exhibit Borings
(MEI 80-293)



SOURCES of SUBSURFACE INFORMATION
Little Rock Zoo Entry Habitats Renovation
Little Rock, Arkansas
Project No. A24184.00500

Grubbs, Hoskyn, Barton & Wyatt, LLC
CONSULTING ENGINEERS
A UES Company

ATTACHMENT 3



PLAN OF BORINGS

BIG CAT EXHIBIT-LITTLE ROCK ZOO-LITTLE ROCK, ARKANSAS

McCLELLAND ENGINEERS

PLATE 1

LOG OF BORING NO. 1

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 2 ft - Wash LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% - NO. 200
			SURF. EL: 397 ±				
			Loose sandstone cobbles and gravel				
			Very stiff gray and tan shaley clay	25			96
5			Hard to very hard tan and gray sandstone with quartz partings and seams				
10							

COMPLETION DEPTH: 8 ft DEPTH TO WATER IN BORING: Dry at 8 ft DATE: 10/7/80
DATE: 10/7/80

McCLELLAND ENGINEERS

PLATE 2

LOG OF BORING NO. 1-A

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 2 ft - Wash

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	NO. 200, %
			SURF. EL: 397 ±				
			Loose sandstone cobbles and gravel				
			Very stiff tan and gray shaley clay				
5			Hard to very hard tan and gray sandstone with quartz partings and seams				
10							

COMPLETION DEPTH: 6 ft
DATE: 10/7/80

DEPTH TO WATER IN BORING: Dry at 6 ft DATE: 10/7/80

LOG OF BORING NO. 2

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 2 ft - Wash

LOCATION: See Plate 1

SURF. EL: 398.5 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	% - NO. 200
			Very stiff tan silty clay with quartz gravel and cobbles	50 - 4 in.			24
5			Very hard quartzitic sandstone				
			Very stiff gray and tan shaley clay				
			Medium hard tan sandstone with quartzitic partings and seams				
10							
			Soft gray weathered shale	50 - 6 in.			
15							
				50 - 2 in.			
20							

COMPLETION DEPTH: 19 ft
DATE: 10/6/80

DEPTH TO WATER IN BORING: Dry at 2 ft DATE: 10/6/80

McCLELLAND ENGINEERS

PLATE 4

LOG OF BORING NO. 3

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 8.5 ft - Wash

LOCATION: See Plate 1

SURF. EL: 396.5 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
			Gravel and broken asphalt		
			Very stiff reddish tan and tan silty clay	26	
5			Very stiff gray and tan shaley clay	47	
			Soft gray shale	50 - 1 in.	
10					

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

% - NO. 200

COMPLETION DEPTH: 8.5 ft
DATE: 10/6/80

DEPTH TO WATER IN BORING: Dry at 8.5 ft DATE: 10/6/80

McCLELLAND ENGINEERS

PLATE 5

LOG OF BORING NO. 5

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 18.5 ft - Wash

LOCATION: See Plate 1

SURF. EL: 389 ±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT
			Asphalt (1 in.) with gravel base		
			Very stiff gray and tan shaley clay	34	
5				40	
			Soft gray and tan weathered shale	50 - 9 in.	
				50 - 6 in.	
10					
15				50 - 3 in.	
				50 - 4 in.	
20					

COHESION, TON/SQ FT
0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT
10 20 30 40 50 60 70

-NO. 200, %

COMPLETION DEPTH: 19 ft
DATE: 10/7/80

DEPTH TO WATER IN BORING: Dry at 19 ft
DATE: 10/7/80

McCLELLAND ENGINEERS

LOG OF BORING NO. 6

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 18.5 ft - Wash

LOCATION: See Plate 1

SURF. EL: 388 ±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	%
	Asphalt (2 in.) and gravel base (3 in.)			
	Very stiff tan and gray shaley clay	36		
5		44		
		50 - 9 in.		
10		50 - 9 in.		
	Soft gray weathered shale	50 - 3 in.		
15		50 - 3 in.		
20				

COHESION, TON/SQ FT: 0.2 0.4 0.6 0.8 1.0 1.2 1.4

PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT: 10 20 30 40 50 60 70

- NO. 200, %

COMPLETION DEPTH: 19 ft
DATE: 10/6/80

DEPTH TO WATER IN BORING: Dry at 19 ft DATE: 10/6/80

McCLELLAND ENGINEERS

PLATE 7

LOG OF BORING NO. 7

BIG CAT EXHIBIT
LITTLE ROCK ZOO
LITTLE ROCK, ARKANSAS

TYPE: Auger to 18.5 ft - Wash LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT (10 20 30 40 50 60 70)	-NO. 200, %
			SURF. EL: 391.5				
			Very stiff tan silty clay with fine sandstone gravel	24			
			Soft tan and gray weathered shale	47			
5				36			
				50 - 6 in			
				50 - 7 in.			
10							
			-quartz gravel seams at 14 and 19 ft				
				50 - 6 in.			
15							
				50 - 6 in.			
20							

COMPLETION DEPTH: 19 ft DEPTH TO WATER IN BORING: Dry at 19 ft DATE: 10/6/80
DATE: 10/6/80

LOG OF TEST PIT NO. 1

BIG CAT EXHIBIT
LITTLE ROCK ZOO

DATE: 11/20/80 TYPE: Backhoe LOCATION: 10,110N 10,260E

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT. LBS./CU. FT.	COHESION, TON/SQ. FT. 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT 10 20 30 40 50 60 70	% RECOVERY
			SURFACE EL.				
			Dark brown gravelly sandy silt with sandstone cobbles and roots				
			Tan and reddish brown gravelly shaley silty clay				
			Tan and gray shaley silty clay				
5			Tan, gray and reddish brown weathered shale -0° DIP 3 to 4 ft -70° to 80° DIP to North below 4 ft				
10							

COMPLETION DEPTH: 8 ft
DATE: 11/20/80

DEPTH TO WATER IN TEST PIT: Dry DATE: 11/20/80

LOG OF TEST PIT NO. 2

BIG CAT EXHIBIT
LITTLE ROCK ZOO

DATE: 11/20/80 TYPE: Backhoe LOCATION: 10,250N 10,110E

DEPTH, FT.	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT. LBS./CU. FT.	COHESION, TON/SQ. FT. 0.2 0.4 0.6 0.8 1.0 1.2 1.4 / PLASTIC LIMIT — WATER CONTENT, % — LIQUID LIMIT 10 20 30 40 50 60 70	% RECOVERY
			SURFACE EL.				
			Tan and reddish brown silty clay with sandstone gravel (POSSIBLE FILL)				
			Tan and reddish brown shaley silty clay				
			Reddish brown and gray shale 70° to 80° DIP to northeast				
5							
10							

COMPLETION DEPTH: 8 ft
DATE: 11/20/80

DEPTH TO WATER IN TEST PIT: Dry DATE: 11/20/80

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B1

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/23/89 JOB NO: 1083

BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: THREET

GROUND ELEV.: 410.4±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth In Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
					4" OF CONCRETE AT SURFACE WITH YELLOWISH BROWN CLAYEY GRAVEL (GC) BASE
	P1			0	VERY SOFT MOIST YELLOWISH BROWN SILTY CLAY (CL) (POSSIBLE FILL) PP = 0.50 TSF
5	P2			16	VERY STIFF MOIST YELLOWISH BROWN FAT CLAY (CH) (RESIDUAL SOIL) PP = 2.25 TSF
10	P3			50/10"	SOFT HIGHLY WEATHERED GRAY AND REDDISH BROWN SHALE WITH NUMEROUS FAT CLAY SEAMS
15	P4			50/3"	HARD HIGHLY WEATHERED GRAYISH BROWN SHALE
20					BOTTOM OF HOLE AT 15.5-FEET IN SHALE. BORING REMAINED OPEN. NO WATER WAS ENCOUNTERED IN THIS BORING.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B2

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/23/89

JOB NO: 1083

BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO

GEOTECHNICIAN: THREET

GROUND ELEV.: 410.8±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth in Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
					5" OF CONCRETE AT SURFACE WITH YELLOWISH BROWN CLAYEY GRAVEL (GC) BASE
	P1			14	STIFF TO VERY STIFF MOIST YELLOWISH BROWN FAT CLAY (CH) WITH ROCK FRAGMENTS PP = 1.50 TSF
5	P2			18	PP = 3.50 TSF
10	P3			50/6"	MODERATELY HARD WEATHERED REDDISH BROWN AND BLACK VARIGATED FISSILE SHALE
15	P4			50/6"	
					BOTTOM OF HOLE AT 15.5-FEET IN SHALE.
20					BORING REMAINED OPEN.
					NO WATER WAS ENCOUNTERED IN THIS BORING.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B3

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/23/89 JOB NO: 1083

BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: THREET

GROUND ELEV.: 410.8±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth In Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
					5" OF CONCRETE AT SURFACE WITH YELLOWISH BROWN CLAYEY GRAVEL (GC)
	P1			4	SOFT MOIST YELLOWISH BROWN SILTY CLAY (CL/CH) (POSSIBLE FILL) PP = 1.75 TSF
5	P2			14	STIFF MOIST YELLOWISH BROWN FAT CLAY (CH) WITH SANDSTONE FRAGMENTS (RESIDUAL SOIL) PP = 2.50 TSF
	P3			38	
10	P4			50/14"	MODERATELY HARD HIGHLY WEATHERED YELLOWISH BROWN SHALE/CLAY (RESIDUAL SOIL-SHALE HORIZON) PP = 4.5+ TSF
	P5			50/9"	MODERATELY HARD HIGHLY WEATHERED GRAY AND BLACK VARIGATED FISSILE SHALE
15					BOTTOM OF HOLE AT 15.5-FEET IN SHALE.
					BORING REMAINED OPEN.
20					PERCHED WATER ENCOUNTERED AT 15.0-FEET.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B4

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/21/89 JOB NO: 1083

BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: BRADBURY

GROUND ELEV.: 410.9±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth In Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
	P1			29	4" OF TOPSOIL
	P2			28	MEDIUM DENSE DRY REDDISH BROWN SILTY SAND (SM) WITH SOME SMALL GRAVELS
5	P3			25	VERY STIFF MOIST LIGHT BROWN AND REDDISH BROWN MOTTLED SHALEY CLAY (CH) WITH SOME SMALL GRAVEL PP = 4.5+ TSF PP = 4.5+ TSF
	P4			50/	HARD HIGHLY WEATHERED LIGHT GRAY SHALE
10	P5			50/8"	
					HARD HIGHLY WEATHERED REDDISH BROWN AND DARK BROWN SHALE
15	P6			50/3"	
20					BOTTOM OF HOLE AT 15.0-FEET IN SHALE. BORING REMAINED OPEN. NO WATER WAS ENCOUNTERED IN THIS BORING.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B5

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/21/89 JOB NO: 1083 BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: BRADBURY GROUND ELEV.: 410.9±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth in Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
	P1			50	4" OF TOPSOIL
					VERY DENSE DRY LIGHT BROWN SILTY SAND (SM) WITH MEDIUM GRAVEL
	P2			50/10"	
					HARD MOIST REDDISH BROWN SHALEY CLAY (CH) WITH SOME QUARTZ GRAVEL
5	P3			50/7"	
					SOFT HIGHLY WEATHERED LIGHT GRAY SHALE
10	P4			50/6"	MODERATELY HARD WEATHERED LIGHT GRAY SHALE
					HARD WEATHERED LIGHT GRAY SHALE
15	P5			50/3"	
					BOTTOM OF HOLE AT 15.0-FEET IN SHALE.
20					BORING REMAINED OPEN.
					NO WATER WAS ENCOUNTERED IN THIS BORING.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B6

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

DATE: 08/21/89 JOB NO: 1083 BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: BRADBURY GROUND ELEV.: 410.8±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth in Feet	Sample Type & No	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
	P1			35	6" OF TOPSOIL DENSE DRY LIGHT BROWN SILTY SAND (SM) WITH SOME SMALL GRAVEL
	P2			27	
5	P3			28	VERY STIFF MOIST LIGHT GRAY AND REDDISH BROWN MOTTLED SHALEY CLAY (CH) WITH SOME QUARTZ FRAGMENTS PP = 4.00 TSF
	P4			50/7"	
10					HARD HIGHLY WEATHERED LIGHT GRAY SHALE
					HARD HIGHLY WEATHERED LIGHT GRAY AND REDDISH BROWN SHALE
15	P5			50/6"	
					BOTTOM OF HOLE AT 16.0-FEET IN SHALE.
20					BORING REMAINED OPEN.
					NO WATER WAS ENCOUNTERED IN THIS BORING.

ANDERSON ENGINEERING CONSULTANTS, INC.
10205 ROCKWOOD ROAD, LITTLE ROCK, ARKANSAS 72204

LOG OF BORING

PROJECT: WAR MEMORIAL PARK
LITTLE ROCK, ARKANSAS

BORING NO: B7

FOR: ALLISON-MOSES-REDDEN

LOCATION: SEE PLAN OF BORINGS

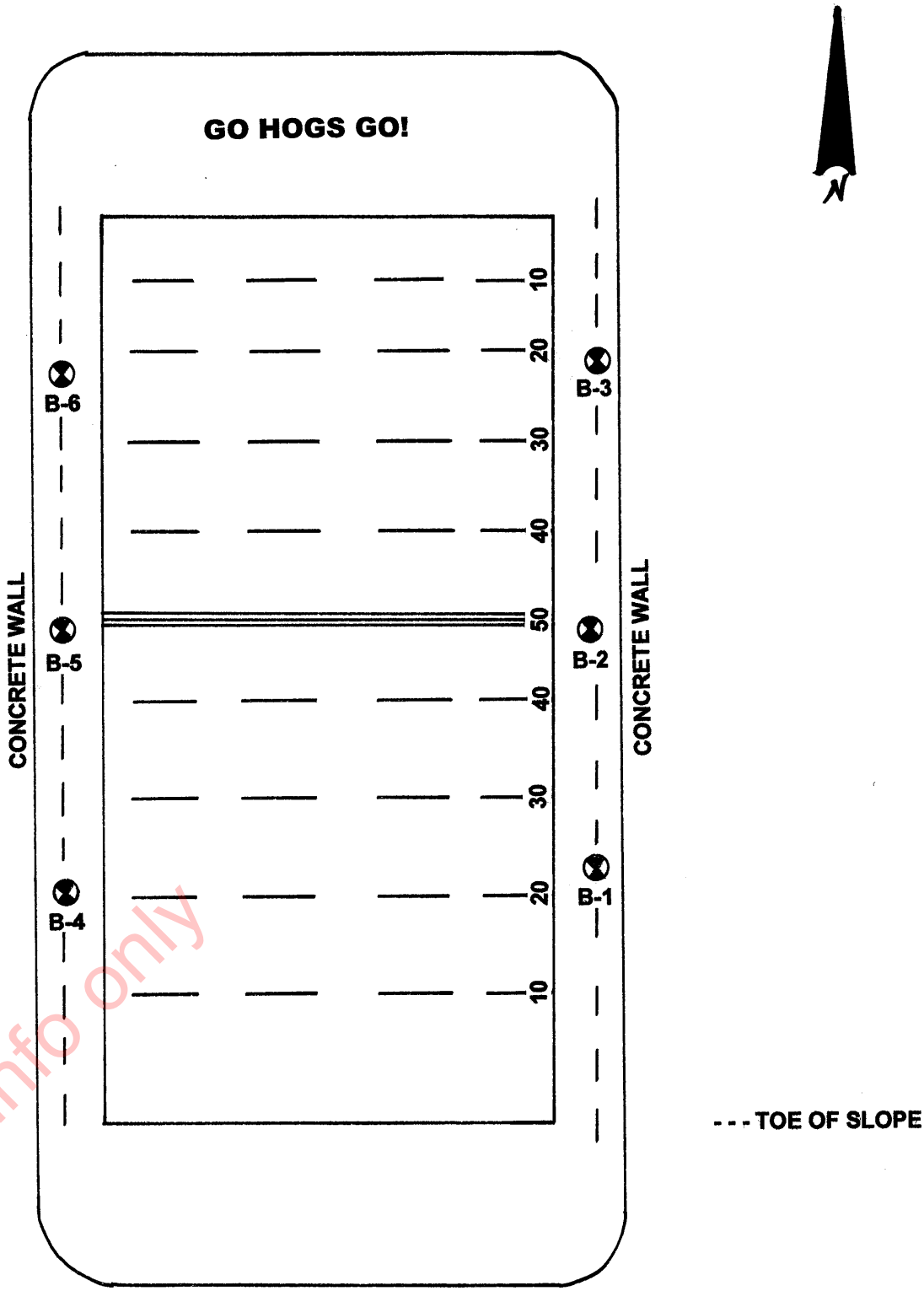
DATE: 08/21/89 JOB NO: 1083 BORING TYPE: AUGER W/SPT

DRILLER: BRADBURY/ SIMCO GEOTECHNICIAN: BRADBURY GROUND ELEV.: 410.1±

LEGEND

S-Shelby Tube | NX-Diamond Core | P-Penetration Test
Core | Penetration Sample | J-Jar
Static Water Table | Hydrostatic Water Table | No Recovery

Depth in Feet	Sample Type & No.	Graphic Symbol	Elevation in Feet	N-Blows Per Foot	VISUAL DESCRIPTION OF STRATUM
	P1			50/3"	4" OF TOPSOIL
	P2			50/6"	VERY DENSE DRY LIGHT BROWN SILTY SAND (SM) WITH SMALL GRAVEL
5	P3			26	HARD MOIST REDDISH BROWN AND YELLOWISH BROWN MOTTLED SHALEY CLAY (CH) WITH SOME SMALL GRAVEL PP = 4.5+ TSF
					VERY STIFF MOIST REDDISH BROWN AND LIGHT GRAY SHALEY CLAY (CH) WITH QUARTZ FRAGMENTS
10	P4			50/7"	
	J5				SOFT HIGHLY WEATHERED LIGHT GRAY AND YELLOWISH BROWN SHALE
15					HARD HIGHLY WEATHERED DARK BROWN SHALE
					BOTTOM OF HOLE AT 14.5-FEET IN SHALE.
20					BORING REMAINED OPEN.
					NO WATER WAS ENCOUNTERED IN THIS BORING.



Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

PLAN OF BORINGS
War Memorial Stadium Seating
Little Rock, Arkansas

SCALE: N.T.S.	JOB NO.: 99-030	PLATE 1 OF 8

99-030

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 1

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod				
			Brown fine sand (fill)				
			Very soft gray and brown highly weathered shale	22			
			- w/quartz fragments below 1 ft				
			Soft gray weathered shale	50/3"			
				50/3"			
5							
				60/3"			
			- brown below 6.5 ft	50/2"			
			- more gray below 8 ft				
10			Medium soft gray shale				
				50/0"			
15			- auger refusal at 15 ft				
20							
25							

COMPLETION DEPTH: 15.0 ft
DATE: 2-3-99

DEPTH TO WATER IN BORING: 3.7 ft at 24 hours

DATE: 2/3/99

LGBNEW 99-030.GPJ 2-10-99

PLATE 2

99-030

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 2

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod Brown fine sand (fill)				
			Tan coarse sand and fine gravel (fill) Brown silty clay and brown highly weathered shale (fill)	50/7"			
5			Soft gray weathered shale	50/6" 50/7"			
			Hard gray shale	50/0"			
			- auger refusal at 8.5 ft	50/0"			
10							
15							
20							
25							

COMPLETION DEPTH: 8.5 ft
DATE: 2-3-99

DEPTH TO WATER IN BORING: 5.2 ft at 24 hrs

DATE: 2/3/99

LGBNEW 99-030.GPJ 2-10-99

PLATE 3

99-030

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 3

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod				
			Brown fine sand w/shale fragments (fill)	50/8"			
			Brown silty clay w/shale fragments (fill)	60/4"			
			Medium soft gray weathered shale				
			Hard gray weathered shale	25/0"			
5				30/0"			
				50/0"			
10							
15							
20							
25							

COMPLETION DEPTH: 9.0 ft
DATE: 2-3-99

DEPTH TO WATER IN BORING: 6 ft at 24 hours

DATE: 2/3/99

LGBNEW 99-030.GPJ 2-10-99

PLATE 4

99-030

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 4

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod Brown fine sand (fill)				
			Brown silty clay w/shale and quartz fragments (fill)	35			
5			- trace sandstone below 5 ft (fill)	36			
			Medium hard light gray highly weathered shale	56/3"			
			Medium to hard weathered gray shale	80/3"			
10							
			- auger refusal at 13.5 ft				
15							
20							
25							

COMPLETION DEPTH: 13.5 ft
DATE: 2-4-99

DEPTH TO WATER IN BORING: Dry at 1 hour

DATE: 2/4/99

LGBNEW 99-030.GPJ 2-10-99

PLATE 5

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 5

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod Brown fine sand (fill)				
			Loose gravel (fill) Soft brown silty clay w/shale fragments (fill)	4			
5				4			
			Very soft dark gray highly weathered shale	46			
			Medium to hard weathered dark gray shale	50/3"			
10							
				30/0"			
15							
20							
25							

COMPLETION DEPTH: 15.0 ft
DATE: 2-4-99

DEPTH TO WATER IN BORING: 3 ft at 3 hours

DATE: 2/4/99

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. 6

War Memorial Stadium Seating
Little Rock, Arkansas

TYPE: Auger

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			SURF. EL: 370.5				
			2 in. sod Dense brown fine sand (fill)	50/10"			
			Brown silty clay w/shale fragments (fill)	50/5"			
			Highly weathered gray shale	50/10"			
5			Medium to hard weathered gray shale - darker gray color w/depth	30/0"			
				50/2"			
10							
15			- auger refusal at 15 ft	50/0"			
20							
25							

COMPLETION DEPTH: 15.0 ft
DATE: 2-4-99

DEPTH TO WATER IN BORING: 8.5 ft at 5 hours

DATE: 2/4/99

LGBNEW 99-030.GPJ 2-10-99

PLATE 7

ISRAEL BOYCOTT RESTRICTION CERTIFICATION

Section 00 45 00 / Rev: August 2021

WDD Project Number: 23-031

Project Name: Little Rock Zoo - Entry Habitats Renovation

Pursuant to Arkansas Code Annotated § 25-1-503, a public entity **shall not** enter into a contract valued at $1,000 or greater with a company unless the contract includes a written certification that the person or company is not currently engaged in and agrees for the duration of the contract not to engage in, a boycott of Israel.

By signing below, the Contractor agrees and certifies that they do not currently boycott Israel and will not boycott Israel during any time in which they are entering into, or while in contract, with any public entity as defined in § 25-1-503*. If at any time after signing this certification the contractor decides to engage in a boycott of Israel, the contractor must notify the contracting public entity in writing.

If a company does boycott Israel, see Arkansas Code Annotated § 25-1-503.

City of Little Rock

Name of Public Entity

Print Name of Company

Contractor Signature and Date

Print Name and Title

AGREEMENT

Agreement between Owner and Contractor
on the Basis of Stipulated Price

(Based on EJCDC 1910-8-A-1, 1990 edition)

THIS AGREEMENT is dated as of the ____ day of _____ in the year 2025 by and between the City of Little Rock (hereinafter called "Owner") and _____ (hereinafter called "Contractor").

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1. WORK

Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: The Re-design of the Little Rock Zoo's Front-Entry Plaza, Surrounding Animal Exhibits, and Corresponding Areas per the Zoo's Master Plan ("Bond Project")

Article 2. ARCHITECT

The Project has been designed by:

Wittenberg, Delony & Davidson Architects
5050 Northshore Lane
North Little Rock, AR 72118

Article 3. CONTRACT TIME

3.1 The Work included in this contract shall be completed within **420** calendar days of the date specified on the Notice to Proceed.

3.2 Liquidated Damages. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1 of this Agreement, plus any extensions thereof allowed in accordance with Article 15 of the General Conditions. The Owner and Contractor also recognize the delays, expense and difficulties involved in proving in a legal proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay, but not as penalty, Contractor shall pay Owner Five Hundred Fifty Dollars **($550)** per day for each day that expires after the time specified in paragraph 3.1 of this Agreement for

completion of Work until the Work is complete and ready for final payment. There shall be no exemptions because of weather conditions if the Owner certifies that work within the structure could have proceeded despite the weather. **The Owner has the right to withhold any such sums as liquidated damages from the final payment to the Contractor.**

Article 4. CONTRACT PRICE

4.1 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents in current funds as follows:

A lump sum Contract Price of $_____ dollars.
(written amount)

Article 5. PAYMENT PROCEDURES

The contractor shall submit Applications for Payment in accordance with Article 19 of the General Conditions. Applications for Payment will be processed as provided in the General Conditions.

5.1 Progress Payments: Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 20th day of each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Article 3 of the General Conditions, and in the case of Unit Price Work based on the number of units completed, or, in the event there is no schedule of values, as provided in the General Conditions.

5.1.1 The Owner shall retain five percent (5%) of the amount of each progress payment to assure faithful performance of the contract. Progress payments will be made in accordance with Article 19 of the General Conditions and, in each case, less the aggregate of payments previously made and less such amounts the Owner may withhold in accordance with Section 3.2 and Article 19 of the General Conditions.

5.1.2 If the Contract Documents allow for phased work in which completion may occur on a partial occupancy, any retention proceeds withheld and retained under the Contract Documents shall be partially released within thirty (30) days under the same conditions under the Contract Documents in direct proportion to the value of the part of the capital improvement completed. All sums withheld by the Owner shall be paid to the Contractor within thirty (30) days after the construction contract has been completed.

5.1.3 In accordance with Ark. Code Ann. § 22-9-604, if the Contractor is required by the Contract Documents to purchase and furnish materials or equipment that will be stored on the job site or in a bonded warehouse and used in the Work, no retainage

will be withheld on that amount of the submitted progress payment pertaining to the cost of these stored materials or equipment.

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with Article 19 of the General Conditions, and after the Owner receives ALL lien waivers and ALL other proper documentation from the Contractor, Owner shall pay the remainder of the Contract Price as provided in said Article 19.

Article 6. CONTRACTOR'S REPRESENTATIONS

In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

6.1 Contractor has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and laws and regulations that in any manner may affect cost, progress, performance or furnishing of the Work. Contractor covenants and agrees to comply with all applicable laws, statutes, regulations, ordinances and permits relating to the performance of this contract.

6.2 Contractor has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions and accepts the determination of the extent of the technical data contained in such reports and drawings upon which Contractor is entitled to rely.

6.3 Contractor has obtained and carefully studied, or assumes responsibility for obtaining and carefully studying, all such examinations, investigations, explorations, tests, reports and studies, in addition to or to supplement those referred to in paragraph 6.2 above, which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise that may affect the cost, progress, performance or furnishing of the Work as Contractor considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Documents. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by Contractor for such purposes.

6.4 Contractor has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data with respect to said Underground Facilities are or will be required by Contractor in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents.

6.5 Contractor has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

6.6 Contractor has given Owner written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by Owner is acceptable to Contractor.

Article 7. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between Owner and Contractor concerning the Work consist of the following:

7.1 This Agreement.

7.2 The bound Project Manual dated _____, 2025.

7.3 Release of Liability and Hold Harmless Agreement dated _____, 2025.

7.4 Performance and Payment Bonds.

7.5 Notice of Award.

7.6 Notice to Proceed.

7.7 General Conditions.

7.8 Supplementary Conditions, if any.

7.9 Specifications.

7.10 Drawings.

7.11 Addenda numbers _____ to _____, inclusive.

7.12 Invitation to Bid, Instructions to Bidders, Bid Form, and Contractor's Bid.

7.13 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All written amendments and other documents amending, modifying or supplementing the Contract Documents pursuant to the provisions of this Agreement and the General Conditions, including any written Change Orders and written Field Orders.

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be amended, modified or supplemented as provided in Subsections 13.1 and 13.2 of the General Conditions and the provisions of this Agreement.

Article 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

8.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation moneys that may become due and moneys that are due may not be assigned without such consent, except to the extent that the effect of this restriction may be limited by law. Unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.3 Owner and Contractor each bind themselves, their partners, successors and legal representatives to the other party hereto, their partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

8.4 Nondiscrimination: Contractor agrees to comply with all applicable federal and state laws and regulations regarding nondiscrimination and specifically agrees not to discriminate against any individual on the basis of race, color, creed, religion, sex, national origin, age, disability, marital status, sexual orientation, gender identity, or genetic information, and to require such compliance in contractual agreements with subcontractors and sub-subcontractors.

8.5 Contractor agrees to comply with the Americans with Disabilities Act and the Equal Employment Opportunity Act, as well as regulations promulgated pursuant thereto, and to require such compliance in contractual agreements with subcontractors and sub-subcontractors.

8.6 Modification: Any modification to this contract shall be in writing, signed by all parties to the contract.

8.7 The Contract Price shall not be increased above $_____, the amount authorized by Resolution No. _____ adopted by the Owner's Board of Directors on _____. Any such increase in the Contract Price shall receive prior written approval by the Owner's City Manager and prior approval by the Owner's Board of Directors in the form of a resolution, if required.

8.8 All Change Orders and Field Orders shall be executed by the Owner. Individuals authorized to execute such Change Orders and Field Orders are the Owner's Project Coordinator, City Manager, or their appointee.

8.9 This contract is governed by the laws of the State of Arkansas.

8.10 Nothing contained in the Contract Documents shall create a contractual relationship with, or cause of action in favor of, a third party against the Owner or Contractor.

8.11 Independent Contractor: It is expressly agreed that Contractor is acting as an independent contractor in performing the services specified herein. The Owner shall carry no workers' compensation insurance, health or accident insurance to cover the Contractor or Contractor's employees for any type of loss which might result to the Contractor or the Contractor's employees in connection with the performance of the Work set forth in this Agreement. The Owner shall not pay any contribution to Social Security, unemployment insurance, federal or state withholding taxes, nor provide any other contributions or benefits which might otherwise be expected in an employer-employee relationship, it being specifically agreed that the Contractor is not acting herein as an employee of Owner, but shall, at all times, and in all respects, have the rights and liabilities of an independent contractor.

8.12 Severability: In the event any section, subsection, subdivision, paragraph, subparagraph, item, sentence, clause, phrase, or word of the Contract Documents is declared or adjudged to be invalid or unconstitutional, such declaration or adjudication shall not affect the remaining provisions of the Contract Documents, as if such invalid or unconstitutional provision was not originally a part of the Contract Documents.

8.13 The statute of limitation period shall be tolled for any fraudulent act committed by the Contractor that the Owner cannot discover upon due diligence.

8.14 The officials who have executed this contract hereby represent and warrant that they have full and complete authority to act on behalf of the Owner and Contractor, respectively, and that their signatures below, the terms and provisions hereof, constitute valid and enforceable obligations of each.

8.15 This Agreement shall be executed in the original, and any number of copies. Any copy of this Agreement so executed shall be deemed an original and shall be deemed authentic for any other use.

8.16 Nothing stated within the Contract Documents shall be construed as limiting the Owner's immunity from liability in tort.

8.17 The Owner does not agree with or consent to arbitration or mediation of disputes relating to this Agreement or Project.

8.18 The Contractor agrees that it shall indemnify and save harmless the Owner, its officers, agents, and employees from any claims or losses for services rendered by any subcontractor, person or firm performing or supplying services, materials or supplies in connection with the performance of this Agreement.

8.19 The Contractor shall ensure that the Owner receives lien waivers from all subcontractors and sub-subcontractors before Work begins on the Project. The Contractor shall give Written Notice to the subcontractors and sub-subcontractors providing Work on the Project that states the following: *"According to Arkansas law, it is understood that no liens can be filed against public property if a valid and enforceable payment and performance bond is in place. Regarding this Project and Agreement, the valid and enforceable bonds are with (name of surety)."* The Contractor shall have each subcontractor and sub-subcontractor execute a written receipt evidencing acknowledgment of this statement.

8.20 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, disability or national origin. The Contractor will take appropriate action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and agrees to post in conspicuous places, available to employees, such notices as may be provided by the Owner setting forth the provisions of this non-discrimination clause. Contractor agrees to comply with the Americans with Disabilities Act, and regulations promulgated pursuant thereto, as relates to the performance of this contract.

8.21 Non-Discrimination: Contractor agrees to comply with all applicable federal and state laws and regulations regarding nondiscrimination and specifically agrees not to discriminate against any individual because of race, color, creed, religion, sex, national origin, age, disability, marital status, sexual orientation, gender identity, or genetic information and to require such compliance in contractual agreements with subcontractors and sub-subcontractors.

8.22 No Waiver of Enforcement of Contract Provisions: Failure of the Owner to enforce at any time any of the provisions of this Agreement, or to require at any time performance by the Contractor of any of the provisions hereof, shall in no way be construed to be a waiver of such provisions, nor in any way to affect the validity of this Agreement, or any part thereof, or the right of the Owner to thereafter enforce each and every such provision.

8.23 Entire Agreement: The Contract Documents contain the complete and entire agreement of the parties respecting the transactions contemplated herein, and supersede all prior negotiations, agreements, representations, and understandings, if any, among the parties regarding such matters. All prior or contemporaneous agreements, understandings, and statements, oral or written, are merged into the Contract Documents.

8.24 Captions: All captions contained in the Contract Documents are inserted only as a matter of convenience and in no way define, limit or extend the scope or intent of the Contract Documents.

ARTICLE 9. INSURANCE AND BONDING

9.1 The Contractor shall provide a Performance Bond, according to Arkansas law, insuring the Owner of the performance of all of the terms, provisions and stipulations of this Agreement. The Contractor shall also provide a Payment Bond, according to Arkansas law. Said Bonds shall be issued by a company duly authorized to transact such business within the State of Arkansas. Said Performance and Payment Bonds shall be acquired and delivered to the Owner prior to the issuance of the Notice to Proceed.

9.2 The Contractor shall furnish the Owner with a certificate of insurance naming the City as an insured on a policy of insurance indemnifying and insuring the City in amounts not less than $ _____ for personal injury and $_____ for property damage and other liabilities. Such insurance shall be acquired and the certificate delivered to the Owner prior to the issuance of the Notice to Proceed. **The Contractor shall give the Owner thirty (30) calendar days advance written notice of any cancellation, reduction, or modification of such insurance.**

ARTICLE 10. TITLE VI CIVIL RIGHTS ACT IMPLEMENTATION AND ASSURANCES

Contractor, and its sub-contractors, sub-recipients, sub-grantees, successors, transferees, or assignees, shall comply with:

(a) Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252) and its applicable federal statutory, regulatory authorities, other pertinent directives, circulars, policy, memoranda, and guidance prohibiting discrimination on the basis of race, color, national origin, age, sex, and disability and give assurance that it will promptly take any measures necessary to ensure such compliance;

(b) all applicable provisions governing the City of Little Rock's and applicable federal department's or agency's access to records, accounts, documents, information, facilities, and staff;

(c) any program or compliance reviews, or complaint investigations, or both, conducted by the City, or federal department or agency;

(d) record retention and reporting requirements, maintain and preserve all project records for a minimum of five (5) years and all requests for documents and materials in a timely, complete, and accurate manner; and

(e) all other reporting, data collection, and evaluation requirements, as required by the City, prescribed by law, or detailed in program guidance.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in duplicate. One counterpart each has been delivered to the Owner and Contractor. All portions of the Contract Documents have been signed or identified by Owner and Contractor.

OWNER:

CITY OF LITTLE ROCK

By: _____
_____, City Manager

Date: _____

ATTEST:

_____
Susan Langley, City Clerk

Date:_____

CONTRACTOR:

_____

By:_____

Date: _____

APPROVED AS TO LEGAL FORM:

Thomas M. Carpenter, City Attorney

By:_____
Beth Blevins Carpenter
Deputy City Attorney

Address for giving notices:

City of Little Rock
Casey Hook
Procurement Coordinator

Address for giving notices:
(Contractor's Address)

Little Rock Zoo
1 Zoo Drive, Little Rock, AR 72205
(501) 661-7213
(503) 863-1317

Employer Identification Number: _____

[End of Section]

PART 1 - GENERAL

1.01 CONTRACTOR'S GUARANTY BOND

A. Contractor shall furnish "Performance and Payment Bond" in amount equal to 100% of contract price, as security for faithful performance of this contract and for payment of all indebtedness for labor and materials furnished or performed in connection with this contract. Bond shall be written by surety company which has qualified and is authorized to do business in the State of Arkansas and must be executed by a resident or nonresident agent who is licensed by the Insurance Commissioner to represent surety company executing said bond and filing with said bond, his power of attorney as his authority. Mere countersigning of a bond will not be sufficient. Bond shall be written in favor of Owner, and executed pursuant to terms of Arkansas Code Annotated §18-44-501 et seq., §18-44-503 et seq., §19-4-1401 et seq., and §22-9-401 et seq. The Surety guarantees that the Principal shall comply with Ark. Code Ann. §22-9-301 et seq. by payment and full compliance with all prevailing hourly wage contract provisions where the contract amount exceeds the amount provided by law. An original and two copies of bond must be furnished, with power of attorney attached to each. Bond must not be dated prior to date of the contract. Contractor shall file (not record) the original with the Clerk in the Circuit Court of the County in which Work to be performed is located. Contractor to pay all expenses incident the filing of bond. Remaining two copies should be certified by the Clerk to evidence filing of original, and these two copies submitted to Architect.

B. Reference is made to AIA Document A312™ - 2010 Performance Bond and AIA Document A312™ - 2010 Payment Bond

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 61 13

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SECTION 00 72 13
GENERAL CONDITIONS

1. Definitions
2. Additional Instruction & Detail Drawings
3. Schedules, Reports & Records
4. Drawings and Specification
5. Shop Drawings
6. Materials, Services & Facilities
7. Inspection & Testing
8. Substitutions
9. Patents
10. Surveys, Permits & Regulations
11. Protection of Work, Property & Persons
12. Supervision by Contractor
13. Changes in the Work
14. Changes in Contract Price
15. Time for Completion & Liquidated Damages
16. Correction of Work
17. Subsurface Conditions
18. Suspension of Work, Termination & Delay
19. Payments to Contractor
20. Acceptance of Final Payment as Release
21. Insurance
22. Contract Security
23. Assignments
24. Indemnification
25. Separate Contracts
26. Subcontracting
27. Land & Rights of Way
28. Guaranty
29. Taxes
30. Architect's Authority

1. DEFINITIONS

1.1 Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1.2 AGREEMENT - Contract between the OWNER and CONTRACTOR regarding the PROJECT.

1.3 ADDENDA - Written or graphic instruments issued prior to the time of opening the bids which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATIONS, by additions, deletions, clarification or corrections.

1.4 BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed.

1.5 BIDDER - Any person, firm or corporation submitting a BID for the WORK.

1.6 BONDS - Bid, Performance, and Payment Bonds, and other instruments of security, furnished by the CONTRACTOR and his surety in accordance with the CONTRACT DOCUMENTS.

1.7 CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion or revision of the WORK within the general scope of the CONTRACT DOCUMENTS or authorizing an adjustment in the CONTRACT PRICE or CONTRACT TIME.

1.8 CONTRACT DOCUMENTS - The contract, including BID, AGREEMENT, Payment Bond, Performance Bond, General Conditions, SUPPLEMENTARY CONDITIONS; NOTICE OF AWARD, NOTICE TO PROCEED, CHANGE and FIELD ORDERS, DRAWINGS, SPECIFICATIONS, and ADDENDA.

1.9 CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS.

1.10 CONTRACT TIME - the number of calendar days stated in the CONTRACT DOCUMENTS for the completion of the WORK.

1.11 CONTRACTOR - The person, firm or corporation with whom the OWNER has executed the Agreement.

1.12 DRAWINGS - The part of the CONTRACT DOCUMENTS which show the characteristics and scope of the WORK to be performed and which have been prepared or approved by the ARCHITECT.

1.13 ARCHITECT- The person, firm or corporation named as such in the CONTRACT DOCUMENTS.

1.14 FIELD ORDER - A written order effecting a change in the WORK not involving an adjustment in the CONTRACT PRICE, or an extension of the CONTRACT TIME, issued by the ARCHITECT and OWNER to the CONTRACTOR during construction.

1.15 NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

1.16 NOTICE TO PROCEED - Written communication issued by the OWNER to the CONTRACTOR authorizing him to proceed with the WORK and establishing the date of commencement of the WORK.

1.17 OWNER - A public or quasi-public body or authority, corporation, association, partnership, or individual for whom the WORK is to be performed.

1.18 PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS.

1.19 PROJECT COORDINATOR or RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site, or any part thereof.

1.20 SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the CONTRACTOR, a SUBCONTRACTOR, MANUFACTURER, SUPPLIER or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed.

1.21 SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards, and workmanship.

1.22 SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the CONTRACTOR, or with any other SUBCONTRACTOR, for the performance of a part of the WORK at the site.

1.23 SUBSTANTIAL COMPLETION - That date, when the construction of the PROJECT, or a specified part thereof, is sufficiently completed in accordance with the CONTRACT DOCUMENTS, so that the PROJECT, or specified part, can be utilized for the purposes for which it is intended.

1.24 SUPPLEMENTARY CONDITIONS - Modifications to adapt the General Conditions to the specific requirements of the Project and that may be imposed by applicable federal, state, and local laws.

1.25 SUPPLIER - Any person or organization who supplies materials or equipment for the WORK, including that fabricated to a special design, but who does not perform labor at the site.

1.26 WORK - All labor necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT. Unless otherwise specified, all materials shall be new, and both workmanship and materials shall be of a good quality. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

1.27 WRITTEN NOTICE - Any notice to any party of the Agreement relative to any part of this Agreement shall be in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party or his authorized representative.

2. ADDITIONAL INSTRUCTION AND DETAIL DRAWINGS

2.1 The CONTRACTOR may be furnished additional instruction and detail drawings, by the ARCHITECT, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS.

2.2 The additional drawings and instruction thus supplied will become a part of the CONTRACT DOCUMENTS. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

3. SCHEDULES, REPORTS AND RECORDS

3.1 The CONTRACTOR shall submit to the OWNER, upon request, such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, and other such records pertaining to the PROJECT.

3.2 Prior to the first partial payment estimate, the CONTRACTOR shall submit construction progress schedules showing the order in which he proposes to carry on the WORK, including dates at which he will start the various parts of the WORK, estimated date of completion of each part and, as applicable:

3.2.1 The dates at which special detail drawings will be required; and

3.2.2 Respective dates for submission of SHOP DRAWINGS, the beginning of manufacture, the testing and the installation of materials, supplies and equipment.

4. DRAWINGS AND SPECIFICATIONS

4.1 The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the WORK in accordance with the CONTRACT DOCUMENTS, and all incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

4.2 It is understood and agreed that the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the WORK, the conformation of the ground, the character of equipment and facilities needed preliminary to and during the execution of the WORK, the character, quality and quantity of the materials to be encountered, the general and local conditions, and all other matters which can, in any way, affect the WORK under this CONTRACT.

4.3 In case of conflict between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over scale dimensions, and detailed DRAWINGS shall govern over general DRAWINGS.

4.4 Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions, or any inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS, shall be immediately reported to the ARCHITECT, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk.

4.5 CONTRACTOR acknowledges that, based upon the CONTRACTOR'S examination of the Drawings and Specifications which comprise a part of the Contract Documents, the CONTRACTOR has not observed anything in the Contract Documents indicating that same are incomplete or inconsistent or otherwise contain any error or omission that would cause the CONTRACTOR to be entitled to make any claim for increases in the CONTRACT PRICE or the CONTRACT TIME.

4.6 The intent of the CONTRACT DOCUMENTS is to include all items necessary for the proper execution and completion of the WORK by the CONTRACTOR. The CONTRACT DOCUMENTS are complimentary, and what is required by one shall be as binding as if required by all; performance by the CONTRACTOR shall be required to the extent inferable from the CONTRACT DOCUMENTS as being necessary to produce the intended results given the CONTRACTOR'S experience in general construction. The SPECIFICATIONS are written in the imperative and abbreviated form. The imperative language is directed to the CONTRACTOR, unless specifically noted otherwise. Any incomplete sentences shall be completed by inserting "shall," "the CONTRACTOR shall," "shall be," and similar mandatory phrases by inference in the same manner as they are applied to notes on the

DRAWINGS. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, all indicated requirements shall be performed whether stated imperatively or otherwise. Further, whenever the term "WORK Includes" or "Section Includes" is used as an article or paragraph heading in a SPECIFICATIONS section, it is merely a listing of the significant items described within the section and is not intended to limit the scope of the section or to imply a trade responsibility.

4.7 Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:

1. The AGREEMENT;
2. AMENDMENTS and revisions of later date take precedence over those of earlier date;
3. SUPPLEMENTARY CONDITIONS;
4. The GENERAL CONDITIONS;
5. The Project Manual;
6. DRAWINGS and SPECIFICATIONS: DRAWINGS GOVERN SPECIFICATIONS for quantity and location, and SPECIFICATIONS govern for quality and performance. In the event of an ambiguity in quantity or quality, the greater quantity and the better quality shall govern;
7. Figure dimensions govern scale dimensions and large-scale DRAWINGS govern small scale DRAWINGS; and,
8. SUBMITTALS; if and only if OWNER concludes, in its sole discretion, that a conflict or discrepancy cannot be otherwise resolved.

5. SHOP DRAWINGS

5.1 The CONTRACTOR shall provide SHOP DRAWINGS as may be necessary for the prompt prosecution of the WORK as required by the CONTRACT DOCUMENTS. The ARCHITECT shall promptly review all SHOP DRAWINGS.

5.2 When submitted for the ARCHITECT'S review, SHOP DRAWINGS shall bear the CONTRACTOR'S certification that he has reviewed, checked, and approved the SHOP DRAWINGS and that they are in conformance with the requirements of the CONTRACT DOCUMENTS.

5.3 Portions of the WORK requiring a SHOP DRAWING or sample submission shall not begin until the SHOP DRAWING or submission has been reviewed by the ARCHITECT. A copy of each processed SHOP DRAWING and each approved sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ARCHITECT AND OWNER.

6. MATERIALS, SERVICES AND FACILITIES

6.1 It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, sewer, light, utilities, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the WORK within the specified time.

6.2 Materials and equipment shall be so stored as to ensure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

6.3 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

6.4 Materials, supplies and equipment shall be in accordance with samples submitted by the CONTRACTOR and approved by the ARCHITECT.

6.5 Materials, supplies or equipment to be incorporated into the WORK shall not be purchased by the CONTRACTOR or the SUBCONTRACTOR(S) subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

7. INSPECTION AND TESTING

7.1 All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

7.2 The OWNER shall provide all inspection and testing services not required by the CONTRACT DOCUMENTS.

7.3 The CONTRACTOR shall provide, at the CONTRACTOR'S expense, the testing and inspection services required by the CONTRACT DOCUMENTS, unless otherwise noted.

7.4 If the CONTRACT DOCUMENTS, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR shall give the ARCHITECT AND OWNER timely notice of readiness. The CONTRACTOR will then furnish the ARCHITECT AND OWNER the required certificates of inspection, testing or approval.

7.5 Inspections, tests, or approvals by the ARCHITECT, OWNER or others shall not relieve the CONTRACTOR from his obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

7.6 The ARCHITECT, OWNER and their **representatives** will, at all times, have access to the WORK. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The CONTRACTOR shall provide proper facilities for such access and observation of the WORK and also for any inspection or testing thereof.

7.7 If any WORK is covered contrary to the written instructions of the ARCHITECT OR OWNER, it shall, if requested by the ARCHITECT OR OWNER, be uncovered for their observation and replaced by the CONTRACTOR at no increase in Contract Price.

8. SUBSTITUTIONS

8.1 Whenever a material, article or piece of equipment is identified on the DRAWINGS or SPECIFICATIONS by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The CONTRACTOR may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the CONTRACT DOCUMENTS by reference to brand name or catalogue number, and if, in the opinion of the OWNER, such material, article, or piece of equipment is of equal substance and function to that specified, the OWNER may approve its substitution and use by the CONTRACTOR. Any cost differential shall be deducted from the CONTRACT PRICE and the CONTRACT DOCUMENTS shall be appropriately modified by CHANGE ORDER. The CONTRACTOR warrants that if substitutes are approved, no major changes in the function or general design of the PROJECT will result. Incidental changes or extra component parts required to accommodate the substitute shall be made by the CONTRACTOR without a change in the CONTRACT PRICE or CONTRACT TIME.

9. PATENTS

9.1 The CONTRACTOR shall pay all applicable royalties and license fees. The CONTRACTOR shall defend all law suits or claims for infringement of any patent rights and save the OWNER AND ARCHITECT harmless from loss on account thereof; however, if the CONTRACTOR has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the OWNER AND ARCHITECT.

10. SURVEYS, PERMITS, AND REGULATIONS

10.1 The OWNER will furnish all boundary surveys and establish all base lines for locating the principal component parts of the WORK, together with a suitable number of benchmarks adjacent to the WORK as shown in the CONTRACT DOCUMENTS. From the information provided by the OWNER, unless otherwise specified in the CONTRACT DOCUMENTS, the CONTRACTOR shall develop and make all detail surveys needed for construction such as slope sheets.

10.2 The CONTRACTOR shall carefully preserve benchmarks, reference points and stakes and, in case of willful or careless destruction, the CONTRACTOR shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

10.3 Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for by the CONTRACTOR unless otherwise stated in the SUPPLEMENTARY CONDITIONS. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith, he shall promptly notify the ARCHITECT AND OWNER, in writing, and any necessary changes shall be adjusted as provided in Section 13, CHANGES IN THE WORK.

11. PROTECTION OF WORK, PROPERTY AND PERSONS

11.1 The CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

11.2 The CONTRACTOR shall comply with all applicable laws, ordinances, rules regulations and orders of any public body having jurisdiction. The CONTRACTOR shall erect and maintain, as required by the conditions and progress of the WORK, all necessary safeguards for safety and protection. The CONTRACTOR will notify owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by

any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the ARCHITECT or OWNER or anyone employed by them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

11.3 In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the ARCHITECT or OWNER, shall act to prevent threatened damage, injury or loss. The CONTRACTOR shall give the ARCHITECT and OWNER prompt WRITTEN NOTICE of any significant changes in the WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall thereupon be issued covering the changes and deviations involved.

11.4 The CONTRACTOR shall confine operations at the PROJECT site to areas permitted by law, ordinances, permits and this AGREEMENT and shall not unreasonably encumber the PROJECT site with materials or equipment.

11.5 The CONTRACTOR shall at all times keep the premises free from accumulation of waste materials or rubbish.

12. SUPERVISION BY CONTRACTOR

12.1 The CONTRACTOR shall supervise and direct the WORK. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR shall employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CONTRACTOR, and all communications given to the supervisor shall be as if given to the CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK.

13. CHANGES IN THE WORK

13.1 The ARCHITECT, UPON the OWNER's approval, may, at any time, as the need arises, order changes within the scope of the WORK without invalidating the Agreement. If such changes increase or decrease the amount due under the CONTRACT DOCUMENTS, or in the time required for performance of the WORK, an equitable adjustment shall be authorized by a CHANGE ORDER.

13.2 The **ARCHITECT,** UPON the OWNER's approval, may, at any time, by issuing a FIELD ORDER, make changes in the details of the WORK. The CONTRACTOR shall proceed

with the performance of any changes in the WORK so ordered by the ARCHITECT and **OWNER** unless the CONTRACTOR believes that such FIELD ORDER entitles the CONTRACTOR to a change in CONTRACT PRICE or CONTRACT TIME, or both, in which event the CONTRACTOR shall give the ARCHITECT and OWNER WRITTEN NOTICE thereof within seven (7) days after the receipt of the ordered change. Thereafter, the CONTRACTOR shall document the basis for the change in CONTRACT PRICE or CONTRACT TIME within thirty (30) days. The CONTRACTOR shall not execute such changes pending the receipt of an executed CHANGE ORDER or further instruction from the ARCHITECT and OWNER.

14. CHANGES IN CONTRACT PRICE

14.1 The CONTRACT PRICE may be changed only by a CHANGE ORDER. The value of any WORK covered by a CHANGE ORDER or of any claim for increase or decrease in the CONTRACT PRICE shall be determined by one or more of the following methods in the order of precedence listed below:

(A) Unit prices previously approved.
(B) An agreed lump sum.
(C) The actual cost for labor, direct overhead, materials, supplies, equipment, and other services necessary to complete the WORK.

15. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

15.l The date of beginning and the time for completion of the WORK are essential conditions of the CONTRACT DOCUMENTS and the WORK embraced shall be commenced on a date specified in the written NOTICE TO PROCEED.

15.2 The CONTRACTOR shall proceed with the WORK at such rate of progress to ensure full completion within the CONTRACT TIME. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the CONTRACT TIME for the completion of the WORK described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the WORK.

15.3 If the CONTRACTOR shall fail to complete the WORK within the CONTRACT TIME, or extension of time granted by the OWNER, then the CONTRACTOR shall pay, to the OWNER, the amount for liquidated damages as specified in Section 3.2 of the AGREEMENT for each calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT DOCUMENTS.

15.4 The CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the WORK is due to the following, and the CONTRACTOR has promptly given WRITTEN NOTICE of such delay to the ARCHITECT and OWNER:

15.4.1 To any preference, priority or allocation order duly issued by the ARCHITECT or OWNER;

1 5.4.2 To unforeseeable causes beyond the control, and without the fault or negligence of, the CONTRACTOR, restricted to acts of God or of the public enemy, acts of the ARCHITECT or OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes and freight embargoes; and

1 5.4.3 To any delays of SUBCONTRACTORS occasioned by any of the causes specified in paragraphs 15.4.1 and 15.4.2 of this article.

16. CORRECTION OF WORK

16.1 The CONTRACTOR shall promptly remove from the premises all WORK rejected by the ARCHITECT or OWNER for failure to comply with the CONTRACT DOCUMENTS, whether incorporated in the construction or not, and the CONTRACTOR shall promptly replace and re-execute the WORK in accordance with the CONTRACT DOCUMENTS and without expense to the OWNER and shall bear the expense of making good all WORK of other CONTRACTORS destroyed or damaged by such removal or replacement.

16.2 All removal and replacement WORK shall be done at the CONTRACTOR'S expense. If the CONTRACTOR does not take action to remove such rejected WORK within ten (10) days after receipt of WRITTEN NOTICE, the OWNER may remove such WORK and store the materials at the expense of the CONTRACTOR.

17. SUBSURFACE CONDITIONS

17.1 The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the ARCHITECT and OWNER by WRITTEN NOTICE of:

17.1.1 Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT DOCUMENTS; or

17.1.2 Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in WORK of the character provided for in the CONTRACT DOCUMENTS.

17.2 The ARCHITECT and OWNER will promptly investigate the conditions, and if ARCHITECT and OWNER jointly find that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK, an equitable adjustment will be made, and the CONTRACT DOCUMENTS will be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder will not be allowed unless the CONTRACTOR has given the required WRITTEN NOTICE, provided that the ARCHITECT and OWNER may, if ARCHITECT and OWNER jointly determine the facts so justify, consider and adjust any such claims asserted before the date of final payment.

18. SUSPENSION OF WORK, TERMINATION AND DELAY

18.1 The OWNER may suspend the WORK, or any portion thereof, for a period of not more than ninety (90) days, or such further time as agreed upon by the CONTRACTOR, by WRITTEN NOTICE to the CONTRACTOR, which notice will fix the date on which WORK shall be resumed. The CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to any such suspension.

18.2 If the CONTRACTOR is adjudged as bankrupt or insolvent, or if the CONTRACTOR makes a general assignment for the benefit of the CONTRACTOR'S creditors, or if a trustee or receiver is appointed for the CONTRACTOR or for any of his property, or if the CONTRACTOR files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or if the CONTRACTOR repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if the CONTRACTOR repeatedly fails to make prompt payments to SUBCONTRACTORS or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the WORK, or if the CONTRACTOR otherwise violates any provision of the CONTRACT DOCUMENTS, then the OWNER may, without prejudice to any other right or remedy and after giving the CONTRACTOR and the CONTRACTOR'S surety a minimum of twenty (20) days' WRITTEN NOTICE, terminate the services of the CONTRACTOR and take possession of the PROJECT and of all materials, equipment, tools, construction equipment and machinery thereon owned by the CONTRACTOR, and finish the WORK by whatever method the OWNER may deem expedient. In such case, the CONTRACTOR shall not be entitled to receive any further payment until the WORK is finished. If the unpaid balance of the CONTRACT PRICE exceeds the direct and indirect costs of completing the PROJECT, including compensation for additional professional services, such excess WILL BE PAID TO THE CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR SHALL PAY THE DIFFERENCE TO THE OWNER. Such costs incurred by the OWNER will be incorporated in a CHANGE ORDER. **The OWNER has the right to withhold any such costs incurred by the OWNER from any payments due the CONTRACTOR.**

18.3 Where the CONTRACTOR'S services have been so terminated by the OWNER, said termination shall not affect any right of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies by the OWNER due to the CONTRACTOR will not release the CONTRACTOR from compliance with the CONTRACT DOCUMENTS.

18.4 After ten (10) days from delivery of a WRITTEN NOTICE to the CONTRACTOR, the OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the PROJECT and terminate the contract. In such case, the CONTRACTOR will be paid for all WORK executed up to the date of termination.

18.5 If, through no act or fault of the CONTRACTOR, the WORK is suspended for a period of more than ninety (90) days by the OWNER, or the WORK is suspended under an order of a court of competent jurisdiction for more than ninety (90) days, or the OWNER fails to pay the CONTRACTOR substantially the sum requested within sixty (60) days of approval and receipt of a request for payment by the OWNER, then the CONTRACTOR may, after thirty (30) days from delivery of a WRITTEN NOTICE to the OWNER, such thirty (30) day WRITTEN NOTICE also giving the OWNER an opportunity to cure any default, terminate the CONTRACT and recover from the OWNER payment for all WORK executed up to the date of termination. In addition and in lieu of terminating the CONTRACT, if the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may, upon twenty (20) days WRITTEN NOTICE to the OWNER, stop the WORK until the CONTRACTOR has been paid all amounts then due, in which event and upon resumption of the WORK, CHANGE ORDERS shall be issued for adjusting the CONTRACT PRICE or extending the CONTRACT TIME, or both, to compensate for the costs and delays attributable to the stoppage of the WORK.

18.6 If, through no act or fault of the CONTRACTOR, the performance of all or any portion of the WORK is suspended, delayed, or interrupted as a result of a failure of the OWNER to act within the time specified in the CONTRACT DOCUMENTS, including default cure time periods, or if no time is specified, within a reasonable time, an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, will be made by CHANGE ORDER to compensate the CONTRACTOR for the costs and delays directly caused by the failure of the OWNER.

19. PAYMENTS TO CONTRACTOR

19.1 At least ten (10) days before each progress payment falls due, but not more often than once a month, the CONTRACTOR shall submit to the ARCHITECT a Partial Payment Estimate filled out and signed by the CONTRACTOR covering the WORK performed during the period covered by the Partial Payment Estimate and supported by such data as the ARCHITECT or OWNER may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the WORK but delivered and suitably stored at

or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the ARCHITECT and OWNER, as will establish the OWNER'S title to the material and equipment and protect the OWNER'S interest therein, including applicable insurance. The ARCHITECT will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing the ARCHITECT'S approval of payment, or return the partial payment estimate to the CONTRACTOR indicating, in writing, the reasons for refusing to approve payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the partial payment estimate. The OWNER will, within thirty (30) days of presentation to the OWNER of an approved partial payment estimate, pay the CONTRACTOR a progress payment on the basis of the approved partial payment estimate. In accordance with Ark. Code Ann. § 22-9-604, the **OWNER** will retain five percent (5%) of the earned amount of the WORK progress shown on the partial payment estimate, excluding materials and equipment on hand but not installed. Further, if the Contract Documents allow for phased work in which completion may occur on a partial occupancy, any retention proceeds withheld and retained under the Contract Documents shall be partially released within thirty (30) days under the same conditions under the Contract Documents in direct proportion to the value of the part of the capital improvement completed. Upon certification of SUBSTANTIAL COMPLETION of the WORK, the retained amount may be reduced to only that amount necessary to assure completion. On completion and acceptance of a part of the WORK on which the price is stated separately in the CONTRACT DOCUMENTS, payment may be made in full, including retained percentages, less authorized deductions. All sums withheld by the Owner shall be paid to the Contractor within thirty (30) days after the construction contract has been completed.

19.2 The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site.

19.3 Prior to SUBSTANTIAL COMPLETION, the OWNER may use any completed or substantially completed portions of the WORK. Such use shall not constitute an acceptance of such portions of the WORK.

19.4 The OWNER will have the right to enter the premises for the purpose of doing work not covered by the CONTRACT DOCUMENTS. This provision shall not be construed as relieving the CONTRACTOR of the sole responsibility for the care and protection of the WORK, or the restoration of any damaged WORK, except such as may be caused by agents or employees of the OWNER.

19.5 Upon completion and acceptance of the WORK, and after the receipt of all lien waivers and other proper documentation from the CONTRACTOR, the OWNER will sign the final payment request as its certification that the WORK has been accepted by the OWNER under the conditions of the CONTRACT DOCUMENTS. The entire balance found to be due the CONTRACTOR, including the retained percentages, but except such sums as may be

lawfully retained by the OWNER, will be paid to the CONTRACTOR within thirty (30) days of completion and final acceptance of the WORK by the OWNER.

19.6 The CONTRACTOR shall indemnify and save the ARCHITECT and OWNER, or the ARCHITECT'S and OWNER'S agents, harmless from all claims growing out of the lawful demands of SUBCONTRACTORS, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the WORK. The CONTRACTOR shall furnish the OWNER and ARCHITECT satisfactory evidence that all obligations of the nature designated above have been paid, discharged, or waived. If the CONTRACTOR fails to do so, the OWNER may, after having notified the CONTRACTOR, either pay unpaid bills or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, where upon payment to the CONTRACTOR shall be resumed, in accordance with the terms of the CONTRACT DOCUMENTS, but in no event shall the provisions of this sentence be construed to impose any obligations upon the ARCHITECT or OWNER to either the CONTRACTOR, his Surety, or any third party. In paying any unpaid bills of the CONTRACTOR, any payment, so made by the OWNER shall be considered as a payment made under the CONTRACT DOCUMENTS by the OWNER to the CONTRACTOR and the OWNER will not be liable to the CONTRACTOR for any such payments made in good faith.

19.7 The CONTRACTOR warrants that upon submittal of a request for payment, all work for which payment has been received by the CONTRACTOR shall be free and clear of liens, claims, security interests or encumbrances in favor of the CONTRACTOR, subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials or equipment relating to the work or project.

19.8 Any payment to the CONTRACTOR by the OWNER, final or otherwise, shall not constitute an acceptance of any WORK not in accordance with the CONTRACT DOCUMENTS.

20. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

20.1 The acceptance by the CONTRACTOR of final payment shall be and shall operate as a release to the OWNER of all claims and all liability to the CONTRACTOR, other than claims in stated amounts as may be specifically excepted by the CONTRACTOR, for all things done or furnished in connection with this WORK and for every act and neglect of the OWNER and others relating to, or arising out of, this WORK. Any payment, however, final or otherwise, will not release the CONTRACTOR or his sureties from any obligations under the CONTRACT DOCUMENTS or the Performance BOND and Payment BOND.

21. INSURANCE

21.1 The CONTRACTOR shall not commence work under this CONTRACT until he or she has obtained all the insurance required under this paragraph and such insurance has been approved by the OWNER, nor shall the CONTRACTOR allow any Subcontractor to commence work on the Subcontract until the insurance required of the Subcontractor has been so obtained and approved. Required insurance policies shall be provided by an insurance company acceptable to the OWNER and that is authorized to do business in Arkansas. All such insurance shall remain in effect until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective WORK in accordance with Section 28.1 below. In addition, CONTRACTOR shall maintain completed operations insurance for at least one (1) year after the date of final completion and furnish OWNER with evidence of continuation of such insurance at final completion. Contractor shall furnish insurance certificates to the OWNER prior to issuance of the NOTICE TO PROCEED. Such certificates shall provide that the OWNER is to receive written notice of cancelled policies a minimum of thirty (30) days before the cancellation or expiration of the policy.

21.2 Worker's Compensation Insurance. The CONTRACTOR shall procure and maintain during the term of this AGREEMENT Worker's Compensation Insurance as required by applicable state law for all of CONTRACTOR'S employees to be engaged in WORK at the site of the PROJECT. The CONTRACTOR shall require any subcontractor hired by the CONTRACTOR for this PROJECT to provide similar coverage for subcontractor's employees. If employees who are not protected by Worker's Compensation Insurance are to be engaged in hazardous work on the PROJECT, the CONTRACTOR or Subcontractor shall provide adequate employer's liability insurance for the protection of their respective employees.

21.3 Liability Insurance. The CONTRACTOR shall procure and maintain in the name of the OWNER and ARCHITECT during the term of this AGREEMENT Contractor's Public Liability Insurance, Contractor's Property Damage Insurance, and Vehicle Liability Insurance in the amounts specified hereunder.

21.3.1 Public Liability and Property Damage Insurance limits of liability shall be as follows:
Bodily Injury and Physical Damage Liability, including death:
$2,000,000 umbrella
$1,000,000 each occurrence

21.3.2 Vehicle Liability Insurance shall be in an amount not less than $1,000,000 for injuries, including accidental death, to any (1) one person, and subject to the same limit for each person, in an amount not less than $1,000,000 for each occurrence.

21.3.3 Contractor's Property Damage Insurance shall be in an amount not less than $1,000,000.

21.4 Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance. The CONTRACTOR shall either (1) require each subcontractor to procure and maintain during the term of the subcontract, Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance of the type and in the amounts specified in subsection 21.3 above; or (2) insure the activities through CONTRACTOR'S policy specified in subsection 21.3 above.

21.5 Scope of Insurance and Special Hazards. The insurance required under subsections 21.3 and 21.4 above shall provide adequate protection for the CONTRACTOR and CONTRACTOR'S subcontractors, respectively, against damage claims which may arise from operations under this AGREEMENT, whether such operations are by the insured or by anyone directly or indirectly employed by the insured.

21.6 The CONTRACTOR shall acquire and maintain, if applicable, Fire and Extended Coverage insurance upon the PROJECT to the full insurable value thereof for the benefit of the OWNER, the CONTRACTOR, and SUBCONTRACTORS as their interest may appear. This provision shall in no way release the CONTRACTOR or CONTRACTOR'S surety from obligations under the CONTRACT DOCUMENTS to fully complete the PROJECT.

22. CONTRACT SECURITY

22.1 The CONTRACTOR shall, within ten (10) days after the receipt of the NOTICE OF AWARD, furnish the OWNER with a Performance BOND and a Payment BOND, each in penal sums equal to the amount of the CONTRACT PRICE, conditioned upon the performance by the CONTRACTOR of all undertakings, covenants, terms, conditions and agreements of the CONTRACT DOCUMENTS, and upon the prompt payment by the CONTRACTOR to all persons supplying labor and materials in the prosecution of the WORK provided by the CONTRACT DOCUMENTS. Such BONDS shall be executed by the CONTRACTOR and a corporate bonding company licensed to transact such business in the state in which the WORK is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these BONDS shall be borne by the CONTRACTOR. If, at any time, a surety on any such BOND is declared a bankrupt or loses its right to do business in the state in which the WORK is to be performed or is removed from the list of "Surety Companies Acceptable on Federal Bonds," CONTRACTOR shall, within ten (10) days after notice from the OWNER to do so, substitute an acceptable BOND (or BONDS) in such form and sum and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such BOND shall be paid by the CONTRACTOR. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable BOND to the OWNER.

23. ASSIGNMENTS

23.1 Neither the CONTRACTOR nor the OWNER shall sell, transfer, assign or otherwise dispose of this AGREEMENT, the CONTRACT DOCUMENTS, or any portion thereof, or of the right, title or interest therein, or any obligation thereunder, without written consent of the other party.

24. INDEMNIFICATION

24.1 The CONTRACTOR shall indemnify and hold harmless the OWNER, and their agents and employees, from and against all claims, damages, losses and expenses, including attorney's fees, arising out of or resulting from the performance of the WORK, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the loss of use resulting therefrom, and is caused in whole or in part by any negligent or willful act or omission of the CONTRACTOR, any SUBCONTRACTOR, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable.

24.2 In any and all claims against the OWNER, or any of their agents or employees, by any employee of the CONTRACTOR, any SUBCONTRACTOR, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation of benefits payable by or for the CONTRACTOR or any SUBCONTRACTOR under workmen's compensation acts, disability benefit acts or other employee benefits acts.

24.3 CONTRACTOR hereby releases, indemnifies and holds harmless the OWNER, its officers, agents and employees from and against any and all loss, damage and expense including, but not limited to; any claim, demand or action for injury, liability or damage to persons or property or, for loss of life; and any and all claims or actions brought by any person, firm, government body or other entity, resulting from, arising from or in connection with contamination of, or threatened contamination of, or adverse effects on, the environment, or violation of any environmental or other statue, ordinance, rule, regulation, order, permit or judgment of any government or judicial entity; and from and against any damages, liabilities, costs, fees, fines, charges, causes of action, law suits, judgments and penalties assessed, including, but not limited to, reasonable investigation and legal expenses in connection with defending any such action, arising from any matter or circumstance on the property regarding the performance of the Work and services under the Agreement between the CONTRACTOR, its officers, agents, employees and assigns, and the OWNER for Work and services provided to the OWNER pursuant to such Agreement.

To evidence proper disposal of all solid waste associated with the Work performed under said Agreement in a legally permitted solid waste disposal facility, CONTRACTOR will provide the OWNER with a receipt for each dump load of solid waste so disposed.

24.4 The obligation of the CONTRACTOR under this paragraph shall not extend to the liability of the ARCHITECT, its agents or employees, arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, CHANGE ORDERS, designs or SPECIFICATIONS.

25. SEPARATE CONTRACTS

25.1 The OWNER reserves the right to let separate contracts for this PROJECT. The CONTRACTOR shall afford other contractors' reasonable opportunity for the introduction and storage of their materials and the execution of their WORK and shall properly connect and coordinate its WORK with theirs. If the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other contractor, the CONTRACTOR shall inspect and promptly report to the ARCHITECT and OWNER any defects in such WORK that render it unsuitable for such proper execution and results.

25.2 The OWNER may perform additional WORK related to the PROJECT itself, or the OWNER may let other contracts containing provisions similar to these CONTRACT DOCUMENTS. The CONTRACTOR will afford the other contractors who are parties to such contracts, or the OWNER if the OWNER is performing the additional WORK, reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK and shall properly connect and coordinate his WORK with theirs.

25.3 If the performance of additional WORK by other contractors or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, WRITTEN NOTICE thereof shall be given by the OWNER to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves additional expense to the CONTRACTOR or entitles the CONTRACTOR to an extension of the CONTRACT TIME, the CONTRACTOR may make a claim therefor as provided in Sections 14 and 15.

26. SUBCONTRACTING

26.1 The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

26.2 All SUBCONTRACTORS and material suppliers utilized on this Project shall be experienced in the type of work required by the Project, reputable, qualified and shall be acceptable to the OWNER.

26.3 The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of the CONTRACTOR'S SUBCONTRACTORS and material suppliers on this PROJECT, and of persons either directly or indirectly employed by them, as the CONTRACTOR is for the acts and omissions of persons directly employed by the CONTRACTOR.

26.4 The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS insofar as applicable to the WORK of SUBCONTRACTORS, and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.

26.5 Nothing contained in the CONTRACT DOCUMENTS will create any contractual relationship between any SUBCONTRACTOR or material supplier and the OWNER.

27. LAND AND RIGHTS-OF-WAY

27.1 Prior to issuance of NOTICE TO PROCEED, the OWNER will obtain all land and rights-of-way necessary for carrying out and for the completion of the WORK to be performed pursuant to the CONTRACT DOCUMENTS, unless otherwise mutually agreed.

27.2 The OWNER will provide to the CONTRACTOR information which delineates and describes the lands owned and rights-of-way acquired.

27.3 The CONTRACTOR shall provide at the CONTRACTOR'S own expense and without liability to the OWNER any additional land and access thereto that the CONTRACTOR may desire for temporary construction facilities, or for storage of materials.

28. GUARANTY

28.1 The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of one (1) year from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees, for a period of one (1) year from the date of SUBSTANTIAL COMPLETION of the system and PROJECT, that the completed system and PROJECT are free from all defects due to faulty materials or workmanship, and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects, including the repairs of any damage to other parts of the system or PROJECT resulting from such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other WORK that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred.

29. TAXES

29.1 The CONTRACTOR shall pay all sales, consumer, use and other similar taxes required by the law of the place where the WORK is performed.

30. ARCHITECT'S RESPONSIBILITIES

30.1 The ARCHITECT will act as the OWNER'S representative during the construction period. The ARCHITECT will jointly decide with the OWNER questions which may arise as to quality and acceptability of materials furnished and WORK performed. The ARCHITECT and the OWNER will jointly interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The ARCHITECT or OWNER will make visits to the site and determine if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

30.2 The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship, and execution of the WORK. Inspections may be made at the factory or fabrication plant of the source of material supply.

30.3 The ARCHITECT will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

30.4 The ARCHITECT and OWNER will jointly make prompt decisions relative to interpretation of the CONTRACT DOCUMENTS.

END OF DOCUMENT 00 72 13

RELEASE OF LIABILITY AND HOLD HARMLESS AGREEMENT

Bid #_____

I, _____, the _____ of _____, as the duly authorized agent for _____ ("**CONTRACTOR**"), hereby release, idemnify and hold harmless the City of Little Rock, Arkansas ("**CITY**"), its officers, agents and employees from and against any and all loss, damage and expense including, but not limited to; any claim, demand or action for injury, liability or damage to persons or property or, for loss of life; and any and all claims or actions brought by any person, firm, government body or other entity, resulting from, arising from or in connection with contamination of, or adverse effects on, the environment, or violation of any environmental or other statute, ordinance, rule, regulation, order, permit or judgment of any government or judicial entity; and from and against any damages, liabilities, costs, fees, fines, charges, causes of action, law suits, judgments and penalties assessed, including, but not limited to, reasonable investigation and legal expenses in connection with defending any such action, arising from any matter or circumstance regarding the performance of the Work under the _____, 2025 Agreement between the **CONTRACTOR** and the **CITY** for the Re-design of the Little Rock Zoo's Front-Entry Plaza, Surrounding Animal Exhibits, and Corresponding Areas per the Zoo's Master Plan ("Bond Project")

_____	_____
CONTRACTOR	DATE
_____	_____
WITNESS	DATE

PART 1 - GENERAL

1.01 EXCAVATION SAFETY PROCEDURES

A. In accordance with Arkansas Code Annotated § 22-9-212 et. seq., the Contractor shall include a separate pay item for trench or excavation safety systems for any trench or excavation which equals or exceeds five (5) feet in depth and this pay item shall be a part of the base bid.

B. The Occupational Safety and Health Administration (OSHA) Safety and Health Regulations for Construction, 29 CFR 1926, Subpart P - Excavations (07-01-2021 Edition), is hereby referenced and incorporated into this Project Manual and must be complied with at all times.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 73 19.13

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PART 1 - GENERAL

1.01 CONTRACT BASIS

A. Work is based upon conditions at site, Project Manual, contract Drawings for Project No. 23-031, all addenda issued and the Contract executed between Owner and Contractor.

1.02 OWNER

A. Wherever term "Owner" or "Owners" is used in the Contract Documents it refers to the City of Little Rock. All papers required to be delivered to Owner shall be delivered to Casey hook, Special Programs Manager, Little Rock Zoo, 1 Zoo Drive, Little Rock, AR 72205.

1.03 ARCHITECT

A. Wherever term "Architect" or "Architects" is used in the Contract Documents it refers to **Wittenberg, Delony & Davidson, Inc., 400 West Capitol Avenue, Suite 1800, Little Rock, Arkansas 72201.**

1.04 RESPONSIBILITIES OF CONTRACTOR

A. Except as otherwise specifically stated in the contract, Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, heat, power, transportation, superintendence, temporary construction of every nature, taxes legally collectible because of the Work and all other services and facilities of any nature necessary to execute Work as shown and/or specified under the contract and deliver it complete in every respect within specified time. Water, light, heat, and power sources are available for use by the owner but the contractor is responsible for any tie-ins.

B. If, during the course of construction of this project, the Contractor discovers errors, inconsistencies or omissions in the Contract Documents, the Contractor will report them to the Architect who will issue written instructions to the Contractor. If the Contractor performs Work knowing there is an error, inconsistency or omission in the Contract Documents without giving notice to the Architect or receiving written instruction from the Architect, the Contractor assumes responsibility for the Work and will bear all costs associated with the performance or correction of the Work.

1.05 COORDINATION OF WORK

A. General Contractor to give special attention for coordination of work by various trades to provide uniform and symmetrical layout and spacing of exposed components which affect the finished architectural design and appearance. Where spacing and related locations are not specifically shown on the drawings, or where in doubt, Contractor's Superintendent shall consult Architect's Representative prior to installation of that part of the Work. Location of electrical and telephone outlets shall be verified with Architect prior to installation.

1.06 PRECONSTRUCTION CONFERENCE

A. Either before or soon after actual award of Contract (but in any event prior to start of construction), Contractor or his representative shall attend Preconstruction Conference with representatives of Owner and Architect. Conference will serve to acquaint participants with general plan of contract administration and requirements under which construction operation is to proceed, and will inform Contractor, in detail, of obligations imposed on him and his subcontractors.

1. Hold pre-installation meetings where select specified product systems required to meet warranty or guarantee, which may include Contractor, Architect, Engineer, Consultant, Installer, Owner’s Representative, and Manufacturer’s Designated Representative.

1.07 CONSTRUCTION DRAWINGS AND SPECIFICATIONS

A. Architect to furnish three (3) sets of contract drawings and specifications, without cost, to General Contractor for use in constructing Work. General Contractor shall supply all contract drawings and specifications to his subcontractors or material suppliers. - Additional sets or partial sets of Bidding Documents (including addenda) requested by General Contractor, will be furnished for actual cost of printing, handling and shipping costs at General Contractor's expense. Bidding Documents may also be obtained in electronic format through Southern Reprographics at www.sriplanroom.com for a non-refundable fee as pre-determined by level of access.

1.08 DEFINITION

A. The word "Provide", as used throughout these specifications, means furnish and install.

1.09 REFERENCE STANDARDS

A. Except as otherwise noted, references throughout Project Manual to Codes, Federal Specifications, ASTM Standards, Association or Industry Specifications and other published standards, are to latest edition or publication of such standards.

1.10 PERMITS

A. Utilizing the contract documents (Project Manual and Drawings) prepared by the Architect and his Consultants, along with information provided by the Owner or his Consultants, the Contractor is responsible for securing permits required to successfully complete the project. This responsibility includes payment for the permit and coordination of all submittals.

1.11 INFORMATIONAL DRAWINGS

A. Drawings bound into working drawing set and labeled as informational drawings are not part of the Contract Documents. Information on these drawings is for reference and coordination only and is not a representation or warranty of existing or proposed conditions. The Architect and Owner are not responsible for interpretations or conclusions made by the Contractor based on these drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 11 00

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PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. Definitions and Explanations: Requirements of work related to each allowance are shown and specified in contract documents. The allowance has been established in lieu of additional requirements for that work, and further requirements thereof will be issued at a later time.

B. Cash allowances stipulated in specifications for this project shall not be made a part of any subcontract agreement by Contractor until materials, work and/or services stipulated have been selected by Owner or Architect. For allowances for materials and installation under a subcontract, Architect will issue supplemental specifications to Contractor to receive a minimum of three (3) subcontract bids for work under the allowance unless instructed otherwise by the Architect.

1.02 SCHEDULE OF ALLOWANCES

		Section	Amount
A.	Testing and Inspecting Services	01 45 23	$10,000
B.	Signage - General Exterior	10 14 00	$1,000
C.	Signage - Exterior (Job Site Sign)	10 14 00	$1,500
D.	Water Features (Refer to Drawings)	Various	$200,000
E.	General Landscaping (including Irrigation)	NA	$225,000

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 21 00

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PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. Type of Alternates: The alternates for this project are deductive type. The work described under the alternates shall be included in the Contractor's base bid and indicated as set forth on the Bid Form.

B. Definition: An alternate is an amount proposed by the Contractor and stated in the proposal to the Owner that will be deducted from the base bid amount if the Owner decides to accept the corresponding change in either scope of work or in products, materials, equipment, systems or installation methods described in Contract Documents.

C. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each alternate is complete and fully integrated into the project.

D. Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

1.02 DESCRIPTION OF DEDUCTIVE ALTERNATES

A. DEDUCTIVE ALTERNATE NO. 1:
   1. Building #4 - Tortoise Building & Habitat in its entirety. Structure, architectural components, architectural habitat, site habitat, finish grading, mechanical, electrical, and plumbing systems to be included in deductive alternate. Rough grading, seeding, 4" top soil and all site utilities 5' beyond new sidewalk shall be included in base bid.

PART 2 - PRODUCTS **(Not Applicable)**

PART 3 - EXECUTION **(Not Applicable)**

END OF SECTION 01 23 00

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Make submittals required by Contract Documents; revise and resubmit as necessary to establish compliance with specified requirements. Submittals which are received from sources other than through the General Contractor's office will be returned by the Architect without action. Submit at least one original of manufacturer's product literature. The remainder of the number of copies required for submittal may be reproductions of manufacturer's literature. **FAX submittals, poor quality reproductions or illegible submittals will not be accepted.**

B. Contractor's submittal of (and Architect's review of) shop drawings, product data or samples which relate to work not complying with requirements of Contract Documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section.

1.03 QUALITY ASSURANCE

A. Coordination of Submittals: Prior to each submittal, carefully review and coordinate all aspects of each item being submitted. By affixing Contractor's approval stamp to each submittal, certify that coordination has been performed.

B. Verify that each item and submittal for it conform in all respects with specified requirements.

C. Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.

1.04 TIMING OF SUBMITTALS

A. General: Make submittals far enough in advance of scheduled dates of installation to provide required time for reviews, securing necessary approvals, possible revision and resubmittal, placing orders and securing delivery.

B. Owner will not bear costs of delays due to late submittals.

1.05 COORDINATION AND SEQUENCING

A. Coordinate preparation and processing of submittals with performance of work so that work will not be delayed by submittals.

B. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect's review with another.

1.06 SUBMITTAL FORMAT AND TRANSMISSION

A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the architect.

B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents. **Bookmark individual submittals exceeding 20 pages, and those with multiple products and systems integrated into a single submission.**

C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied.

D. E-mail electronic submittal documents smaller than 5MB in size to e-mail addresses as directed by the architect.

E. Provide electronic documents over 5MB through an electronic FTP file sharing system. Confirm that the electronic FTP file sharing system can be accessed from the architect's computer network. The Contractor is responsible for setting up, providing, and maintaining the electronic FTP file sharing system for the construction contract period of performance.

F. Provide hard copies of submittals when requested by the architect. Up to 3 additional hard copies of any submittal may be requested at the discretion of the architect, at no additional cost to the owner.

PART 2 - PRODUCTS

2.01 PROGRESS SCHEDULE

A. Within 7 days after Notice to Proceed, submit to Architect a bar-chart type progress schedule indicating time bar for each trade or operation of work to be performed. Time bar shall demonstrate planned work, properly sequenced and intermeshed, for expeditious completion of Work. Identify phases if required.

B. Distribute progress schedule including all updates to Architect, Owner, subcontractor, suppliers, fabricators, and others with need-to-know schedule compliance requirements. Post copy in field office.

2.02 SCHEDULE OF VALUES

A. Immediately after execution of the Contract Documents, Contractor shall submit for approval a Schedule of Values totaling the amount of the Contract.

2.03 LIST OF SUBCONTRACTORS

A. Immediately after execution of the Contract Documents, Contractor shall submit for approval a listing of all subcontractors to be used for the project stating portions of Work to be performed, address and telephone number of firm, and contact at firm familiar with project.

B. If all subcontrators have not been determined, submit a partial listing with regular updates indicating newly added subcontractors.

2.04 NOT APPLICABLE

2.05 SUBSTITUTION REQUESTS

A. Products specified herein establish a quality standard for comparison by manufacturers of similar products. Products of other manufacturers may be substituted for those specified herein on an "Approved Equal" basis. DO NOT propose the substitution of products that do not meet or exceed the quality standards established by the specified product. Products proposed as equivalent MUST be submitted through the General Contractor for review by the Architect after the Contract for Construction is awarded. DO NOT request approval of products prior to the awarding of the contract.

B. Requests for substitution will be reviewed when extensive revisions to contract documents are not required and changes are in keeping with general intent of Contract Documents; when timely, fully documented and properly submitted; and when one or more of following conditions is satisfied, all as judged by Architect/Engineer. Otherwise, requests will be returned without action except to record non-compliance with these requirements.
   1. Where request is directly related to an "or equal" clause or other language of same effect in Contract Documents.
   2. Where required product, material or method cannot be provided within Contract Time, but not as a result of Contractor's failure to pursue the Work promptly or to coordinate various activities properly.
   3. Where required product, material or method cannot be provided in a manner which is compatible with other materials of the Work, or cannot be properly coordinated therewith, or cannot be warranted as required, or cannot be used without adversely affecting Owner's insurance coverage on completed work, or will encounter other substantial non-compliance items which are not possible to

otherwise overcome except by making requested substitution, which Contractor thereby certified to overcome such non-compatibility, non-coordination, non-warranty, non-insurable or other non-compliance as claimed.

4. Where required product, material or method cannot receive required approval by a governing authority, and requested substitution can be so approved.

C. **SUBSTITUTIONS REQUESTS MUST BE SUBMITTED WITHIN 45 DAYS AFTER THE DATE OF THE NOTICE TO PROCEED**. Substitution requests received after that time will be returned and the Contractor will be required to provide the product specified, except in the following instances:

1. Unavailability of product, material or method, not due to the Contractor's failure to pursue the work promptly or to coordinate various activities properly.
2. Where a specified product or material contains a hazardous material, as defined in 40 CFR 261 and as defined by applicable state and local regulations and of which the Owner and Architect refuse to approve for use, based on Contractor furnished information.

D. Submit request for substitutions in writing using the Substitution Request form found at the end of this Section. This is the only form that will be accepted.

E. Submit 3 copies of substitution request, fully identified for product or method being replaced by substitution, including related specification section and drawing number(s), and fully documented to show compliance with requirements for substitutions. Include manufacturer's product data/drawings, description of installation methods, material samples where applicable, complete color and finish selection cards or samples, Contractor's detailed comparison of significant qualities between specified item and proposed substitution, statement of effect on construction time and coordination with other affected work, cost information or proposal, and Contractor's statement to the effect that proposed substitutions will result in overall work equal-to-or-better-than work originally indicated.

F. Failure to provide the requested data and samples within the specified time frame will be grounds for rejection as a comparable product.

G. Do not incorporate substitutions into Shop Drawings until they have been reviewed by the Architect and written permission has been issued to make the proposed substitution a part of the contract.

H. Under no circumstances shall Architect's review of any such substitution relieve Contractor from timely, full and proper performance of Work.

I. In the event that the substitution of a product by the General Contractor necessitates the redrawing, redesign, modification or other change to the Contract Documents, the General Contractor will bear all associated costs of these changes.

2.06 REQUEST FOR SUPPLEMENTARY INFORMATION

A. Make timely requests of Architect for additional information required in planning and production of Work.

B. File requests in ample time to permit appropriate action by all parties involved and avoid delay in performance of Work.

C. Owner will not bear costs for delays due to Contractor's failure to request information in a timely manner.

2.07 SHOP DRAWINGS

A. Provide newly-prepared information, on reproducible sheet formats, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Do not duplicate and submit Architect's construction drawings as shop drawings. Show dimensions and notes which are based on field measurement. Identify materials and products in work shown. Indicate compliance with standards, and special coordination requirements. **DIGITAL SUBMISSIONS ARE ALLOWED**.

B. Shop drawings must bear Contractor's approval stamp. This approval stamp certifies that the Contractor has reviewed the shop drawings, product data, samples or similar submittals for conformance with the Contract Documents. All deviations will be noted in writing and highlighted on the submittal for Architect's review. The Architect is not responsible for errors, omissions or deviations in the shop drawings, product data, samples or similar submittals by the Contractor.

C. Submittals are reviewed by the Architect for design intent only. The Contractor is responsible for verification of dimensional requirements, compliance with contract documents and local codes, quantities and coordination of all affected trades.

D. Under no circumstances shall Architect's review of shop drawings or submittals relieve Contractor from timely, full and proper performance of Work in accordance with the Contract Documents.

E. Contract Documents (including all drawings, specifications, addenda and supplemental information) will not be made available in any digital format or on any other reproducible media to Prime Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Prime Bidders may obtain Bidding Documents in electronic or paper format through Southern Reprographics at www.sriplanroom.com for a non-refundable fee as pre-determined by level of access.

F. CAD files will be available to the successful Contractor or Sub-contractors with a release letter or per AIA Document C106™ - 2013 Digital Data Licensing Agreement, after the award of a Contract.

2.08 PRODUCT DATA

A. Collect required data into one submittal for each unit of work or system; mark each copy to show which choices and options are applicable to project AND WHICH ARE AVAILABLE FOR SELECTION BY THE ARCHITECT WITHOUT ADDITIONAL COST. NO PAYMENT WILL BE MADE FOR ADDITIONAL COST OF ANY CHOICES OR OPTIONS SUBMITTED BY THE CONTRACTOR FOR SELECTION BY THE ARCHITECT AND NOT CLEARLY SHOWN AS NOT AVAILABLE WITHIN THE CONTRACT.

B. Include manufacturer's standard published recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements.

C. Maintain one set of product data (for each submission) at project site, available for reference by Architect and others.

D. Do not submit product data until compliance with requirements of contract documents has been confirmed by Contractor.

E. Copies:
   1. Submit 3 paper copies of product data for Architect's review for items specified in various specification sections, **unless digital submission**.
   2. Three paper copies required for mechanical and electrical data, **unless digital submission**.

F. Installer's Copy: Do not proceed with installation of materials, products or systems until final authorized copy of applicable product data is in possession of installer.

G. **Material Safety Data Sheet (MSDS):** MSDS provides basic information on a material or chemical product. A MSDS describes the properties and potential hazards of the material, how to use it safely, and what to do in an emergency. DO NOT PROVIDE WITHIN A SHOP DRAWING SUBMISSION UNLESS SPECIFICALLY REQUESTED BY THE DESIGN PROFESSIONAL. MSDS information shall be kept on file with the contractor and subcontractors for reference. Refer to OSHA MSDS Rules for clarification at website: https://msdsauthoring.com/msds-safety-data-sheet-chemicals-osha-msds-rules.

2.09 SAMPLES

A. Unless precise color and pattern is specified in Contract Documents, submit accurate color and pattern charts or actual material samples to Architect for selection. Refer to pertinent sections of specifications for detailed submission requirements. Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than 3 units) where unavoidable variations must be expected, and describe or identify variations between units of each set.

B. Make all submissions affecting color selection within sufficient time to allow selection without causing delay in Work.

C. Submit items requiring color selection or verification AS ONE SUBMISSION to facilitate coordination of all colors at one time. Interior items may be submitted separately from exterior items.

D. Provide full set of optional samples where Architect's selection is required. DO NOT INCLUDE OPTIONS REQUIRING ADDITIONAL COST.

E. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by Architect. Architect will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of Contractor.

F. Submit 3 sets of samples in final submittal.
   1. Furnish two sets to Architect and assemble one set on site. When all samples are on site, Owner and Architect are to review. Contractor shall provide job samples indicating finished color selections for any and all items requiring finish color for project.
   2. Quality Control Set: Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Architect and Owner. Written approval from Owner is required before the work is begun for any finish requiring color review.

G. Reusable Samples: Returned samples which are intended or permitted to be incorporated into Work must be in undamaged condition at time of use.

2.10 STRUCTURAL SUBMITTALS

A. Structural submittals, where required, include shop drawings, design calculations, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project directly related to the structural design of the project.

B. Contractor shall make all submittals in advance of installation or construction to allow sufficient time for review.

C. Work requiring shop drawings, whether called for by the Contract Documents or requested by the Contractor, shall not commence until the submission has been reviewed by the Architect/Structural Engineer. Work may commence if the Contractor verifies the accuracy of the Architect/Structural Engineer's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

PART 3 - EXECUTION

3.01 SUBMITTAL PREPARATION

A. Permanently mark each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking.

B. Indicate project, date, "To:"; "From:"; names of subcontractors, suppliers, manufacturers, required references, category and type of submittal, purpose, description, distribution record and signature of transmitter.

C. Indicate drawing number and specifications section number to which submittal applies.

3.02 ARCHITECTS ACTION ON SUBMITTALS

A. Architect will respond to submittals from Contractor by completing the "LETTER OF TRANSMITTAL" form.

B. Architect's Submittal Review: Submittal review does not relieve Contractor(s) of compliance with Contract Documents or local codes. Review is only for conformance with the design intent of the Project and compliance with information given in the Contract Documents. The contractor is responsible to coordinate and to confirm all dimensions for use at the site. The contractor is responsible for coordination of the work of all trades.

C. Architect's Action: Where action and return is required or requested, Architect will review each submittal and mark per the following, and where possible return within fifteen (15) working days of receipt. When a submittal must be coordinated with submittals of other trades, Contractor is responsible for gathering all information and forwarding to Architect as a single submittal.

D. Architect's Response:
1. Final Unrestricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with Contract Documents, when submittal is returned with the following: **Marking: "Reviewed".**
2. Final-But-Restricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with Contract Documents, when submittal is returned with the following: **Marking: "Reviewed and Noted".**
3. Returned for Resubmittal: Do not proceed with work. Revise submittal in accordance with notations thereon, and resubmit without delay to obtain a different action marking. Do not allow submittals with the following marking (or unmarked submittals where a marking is required) to be used in connection with performance of the Work: **Marking: "Revise and Resubmit".**
4. Other Action: Where submittal is returned for other reasons, with Architect explanation included, it will not be marked or marked "Revise and Resubmit".

END OF SECTION 01 33 00

WITTENBERG, DELONY & DAVIDSON, INC.
5050 Northshore Ln
North Little Rock, AR 72118
Tel: 501-376-6681 Fax: 501-372-6317

SUBSTITUTION REQUEST

WDD does NOT Pre-Qualify before bidding
To Be Submitted AFTER Award of Contract

Project:
Project No:

Date:
Contractor:
Contact Person:

Contractor hereby requests consideration of a product substitution as follows:

1. Refer To: Section - _____ and/or Drawing - _____
2. Item Description: _____
3. Proposed Substitution:
   Manufacturer: _____
   Model Number: _____
   Description: _____
4. Reason for Substitution:
   ___ Availability
   ___ Delivery Schedule
   ___ Cost Advantage
   ___ Quality Advantage
   ___ Performance Advantage
   ___ Other: _____
5. Coordination:
   Difference in dimensions between the specified and proposed substitute **(WILL) (WILL NOT)** affect dimensions on drawings and adjacent items.

   Describe the effect of the substitution on work of other trades: _____

   Describe the effect of the substitution on other required new or existing materials including electrical wiring, piping, ductwork, finishes, structure, etc.: _____

   Acceptance of this substitution will cause **(NO CHANGE IN) (A REDUCTION OF_____ DAYS FROM)** the completion date of this project.

   Describe any required architectural or engineering design changes required to accommodate the substitution: _____
6. Differences:
   The proposed substitution **(MEETS) (DOES NOT MEET)** the reference standards (ASTM, AWI, UL, etc.) as specified.

   The proposed substitution **(MEETS) (DOES NOT MEET)** the fire rating classification (class, type, FM, UL, NFPA) as specified.

   The proposed substitution is available in the following **(COMPARABLE) (LIMITED) (ADDITIONAL)** finishes.

   Note: Any additional cost associated with proposed substitute finishes will be absorbed by the contractor if this substitution is approved and implemented.

7. Warranty:
   Specified Warranty Length and Coverage:_____
   Substitute Warranty Length and Coverage (Sample warranty attached):_____
   _____
8. This substitution will result in a cost savings and credit of $_____.
9. The proposed substitute has been used in the following installations (attached):_____
   _____
10. Service and replacement material are available from the following (attached):_____
    _____

By submitting this Request for Substitution, the Contractor accepts the following terms and conditions:

1. The proposed substitution, if accepted, will provide performance equivalent to the material or equipment specified. Should a substitution be accepted and should the substitute material or equipment prove defective or otherwise unsatisfactory for the service intended, the Contractor will replace the material or equipment with the material or equipment specified.
2. If the substitution will affect a correlated function, adjacent construction, or work of other trades or contractors, the necessary changes and modifications to affected work are considered to be part of the substitution and will be accomplished without additional cost to the Owner.
3. In the event that the substitution of materials or equipment necessitates the redrawing, redesign, modification or other change to the Contract Documents, the General Contractor will bear all associated costs of these changes.

Contractor warrants that they have verified and believe this substitute is equal or superior to the specified item in all respects. There will be no additional cost associated with coordinating installation of this substitute. Costs and effects of the substitution, as outlined herein, are certified and complete. Claims for additional costs related to acceptance of this substitution, which may become apparent later, are waived.

Manufacturer's product cut sheets, drawings, samples, data sheets, sample warranties, manufacturer's certification, etc. for the substitute are attached.

Contractor:_____ Date:_____

By:_____

Typed Name:_____

Architect's Action:

_____ Substitution is Accepted
_____ Substitution is Rejected for the following reason(s):_____
_____

By:_____

Typed Name:_____

Date:_____

PART 1 - GENERAL

1.01 INTENT

A. These procedures apply to requirements for patching and repairing around new and existing work.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section.

1.03 SITE VISIT

A. Review existing site conditions during bid period. Investigate ceiling plenums, duct shafts, wall structures and other building systems affected by the Work.

B. Confirm dimensions of applicable existing equipment with field measurements.

C. Use visit to note required materials which may be difficult provide and notify the owner's representative as soon as possible.

1.04 SUBMITTALS

A. Comply with requirements of Section 01 33 00.

B. Submit drawings of structural alterations and temporary support systems for review before proceeding with structural alterations.

C. Provide drawings fully detailing alterations to structure, signed, and sealed by a professional structural engineer registered to practice in Arkansas.

D. Submit, for the responsible design professional's approval, details of methods other than specified coring, drilling, or cutting.

1.05 STRUCTURAL ALTERATIONS

A. Do not cut, cut into, or alter any building structure, or bearing walls and partitions until proposed methods and procedures for doing so, including temporary support system, are reviewed by the responsible design professional.

B. Conform strictly to approved details. Cut or remove only to extent shown on engineer's drawing.

1.06 SPECIAL PROTECTION REQUIREMENTS

A. Protect unaffected finishes, equipment and adjacent work from damage caused by cutting, moving, removal and patching operations. Protect surfaces which will remain as part of finished work.

B. Notify the responsible design professional's representative immediately of damage to fireproofing coatings.

C. Protect fireproofing coating to structural members. If damaged due to work of this Contract, restore damaged areas to original condition using materials to match existing color, texture and required fire protection rating.

D. Protect personnel, building occupants and public from airborne dust and contaminants when cleaning spray fireproofing or contaminant-generating materials from structure.

E. Protect area below welding work from sparks and molten metal, using wet double canvas blankets.

1.07 CUTTING, REMOVAL AND FITTING

A. Make cuts with clean, true, smooth edges. Provide patches inconspicuous in final assembly.

B. Use electric percussion tools to cut clay tile, plaster, and concrete blocks.

C. Carefully remove material being cut. Do not cut services discovered.

D. Where required, carefully remove modular, manufactured type finishes, including lay in ceiling tile in component ceiling systems.

E. Fit alteration work airtight to pipes, sleeves, ducts, conduits, and other required penetrations through building elements.

1.08 MATERIALS

A. Obtain new products to patch, match or extend existing products and meet or exceed quality of existing products.

B. Quality of existing products, available for assessment during pre bid site visit, shall serve as basis for requirements for appearance and performance of materials used in the Work.

C. Where existing material cannot be matched with new, salvaged material may be used subject to approval by the responsible design professional.

D. Where matching materials are not available, the design professional will consider a similar product which meets the same performance requirements as existing.

E. Obtain acceptance of the design professional before installing any materials not matching existing.

1.09 PATCHING, EXTENDING AND REPAIRING EXISTING WORK

A. Patch, extend and make good existing work using skilled workers able to match existing quality. Quality of work shall meet technical requirements for similar components throughout Specifications.

B. Where a portion of existing finished surface is damaged, lifted, stained, or otherwise imperfect, patch or replace with matching materials. Match existing finishes unless specified otherwise.

C. If patched or imperfect surface was painted or coated, repaint, or recoat entire surface area.

D. Replace damaged lay-in type ceiling tile and other components with new.

E. Patch surfaces and materials exposed by partition removal, with finishes to match adjacent.

F. Restore existing work damaged during construction to a condition matching existing finishes.

1.10 TRANSITIONS

A. Make transitions as smooth as possible where new work abuts or finishes flush with existing work.

B. Match existing adjacent work in texture and appearance, providing transition invisible to the eye from distance of 8 feet.

C. When smooth transition is not practicable, e.g., from a smooth finish to masonry, tile, or plaster, terminate existing surface along a straight line at a natural point of division and provide trim as required.

D. Where two or more spaces become one space and planes are nominally continuous, re-work floors and walls and ceilings to provide planes meeting without breaks, steps, or bulkheads.

E. Where change of plane exceeds 3 inches (75 mm), obtain instructions from the responsible design professional for method of executing transition.

1.11 EXISTING SERVICES

A. Establish location and extent of services in area of work and notify the design professional of findings before starting Work.

B. Inform the Province immediately of unknown services that are encountered. Confirm findings in writing.

1.12 ALTERATIONS TO MECHANICAL AND ELECTRICAL SERVICES

A. Refer to mechanical and electrical drawings and Divisions 20-23 and 26 of the Specifications for extent of mechanical and electrical alterations.

B. Perform alterations with minimum disturbance to existing work.

C. Access service runs in ceiling spaces through light fixture openings and ceiling access panels where possible. Subject to the Province's approval, provide bulkheads to conceal services where ceiling spaces are not accessible.

D. Except in mechanical and electrical rooms, using chases and cut outs in walls and floors, underfloor ducts, and ceiling spaces, conceal the following:
1. ducts
2. pipes
3. raceways
4. conduit runs
5. junction boxes

E. Patch and make good existing work, where damaged due to alterations to and installation of services.

1.13 CORING, DRILLING AND SAW-CUTTING CONCRETE

A. Complete an x-ray inspection of affected concrete area before coring. Employ the services of an experienced x ray inspector. Confirm with the Province before coring or drilling, location of reinforcing steel and raceways that may be present.

B. Perform coring and drilling after normal working hours, unless specified otherwise.

C. Wet or dry core drilling and saw-cutting are acceptable. Reduce the amount of cooling water used to the minimum required and collect water used in suitable containers or use a suitable vacuum system that will collect water.

PART 2 - PRODUCTS - Not Used -

PART 3 - EXECUTION - Not Used -

END OF SECTION 01 35 16

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of 5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
   1. Mockups are used for 1 or more of the following:
      a. Verify selections made under Sample submittals.
      b. Demonstrate aesthetic effects.
      c. Demonstrate the qualities of products and workmanship.
      d. Demonstrate successful installation of interfaces between components and systems.
      e. Perform preconstruction testing to determine system performance.
   2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
   3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Necessary design elements required for a complete and functional installation, as part of the Delegated Design Services requirements, shall be submitted for review to, and approval by, the Architect or Landscape Architect.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with 2 or more standards or requirements is specified and the standards or requirements establish different or

conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

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

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings:
   1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
   2. Indicate manufacturer and model number of individual components.
   3. Provide axonometric drawings for conditions difficult to illustrate in 2 dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor’s Qualifications: Contractor shall submit a list of 5 previous projects completed successfully. Projects shall be completed within the last 10 years.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
   2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

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

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.

3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor Responsibilities:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project unless otherwise indicated in individual sections.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups of size indicated.
   2. Build mockups in location indicated or, if not indicated, as directed by Architect.
   3. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
   4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
   5. Demonstrate the proposed range of aesthetic effects and workmanship.
   6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
      a. Allow 7 days for initial review and each re-review of each mockup.
   7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
   8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
   1. Engage a qualified testing agency to perform quality-control services.
      a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
   6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
   1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Testing laboratory services and inspection services.

B. Contractor to include, in Base Bid, cost of all field and laboratory testing which is required by various sections of Technical Divisions of these specifications. This will include, but is in no way limited to the following tests:

1. Soil Compaction
2. Soil Bearing
3. Parking Lots:
    a. Subgrade Densities
    b. Base Course Densities
    c. Asphalt Densities
    d. Core Samples to Determine Asphalt Thickness
4. Concrete:
    a. Making Test Cylinders
    b. Compression Tests
    c. Concrete floor moisture vapor emission, in-situ relative humidity and pH (alkalinity) testing at concrete substrates scheduled to receive finish flooring as indicated on Drawings and/or specified in various finish flooring sections. Refer to current version of ASTM F 2170.
        1) Testing shall be conducted based on flooring moisture and pH tolerance requirements submitted by finish flooring trades.
        2) Areas failed to achieve the required moisture and/or pH levels shall be re-mitigated and re-tested at no additional cost to the Owner.
        3) Moisture vapor and pH Test results shall be signed off by respective flooring manufacturers and installers to obtain full warranty on flooring product and installation.
        4) The Owner may conduct and pay for his own random moisture and pH tests at his sole discretion to verify and confirm General Contractor's test results.
        5) Information on grout mixing and placement, and on grout testing is contained in Grouting Concrete Masonry Walls, **TEK 3-2A** and Grout Quality Assurance, **TEK 18-8B** (refs. 1,2), respectively, as published in the National Concrete Masonry Association (NCMA).
5. Structural Steel Welding
6. Topsoil analysis of existing and that brought in off-site
7. Other tests required by Specification Sections

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALIFICATIONS OF LABORATORIES

A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.

B. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as used in Construction".

C. Authorized to operate in state where project is located.

D. Testing equipment must be calibrated at reasonable intervals by devices of accuracy, traceable to either National Bureau of Standards or accepted values of national physical constants.

1.05 LABORATORIES DUTIES

A. Perform specified inspections, sampling and testing of materials and methods of construction. Comply with specified standards. Ascertain compliance of materials with requirements of projects.

B. Promptly notify Architect and Contractor of observed irregularities or deficiencies of work or products.

C. Promptly submit written report of each test and inspection; two copies to Architect and one copy to Contractor for record document files. Each report shall include the following:
   1. Date issued
   2. Project title and number
   3. Testing laboratory name, address and telephone number
   4. Name and signature of laboratory inspector
   5. Date and time of sampling or inspection
   6. Record of temperature and weather conditions
   7. Date of test
   8. Identification of product

9. Location of sample or test in project
10. Type of inspection or test
11. Results of tests and compliance with contract documents
12. Interpretation of test results, when requested by owner or owner's representative.

1.06 LIMITATIONS OF AUTHORITY OF TESTING LABORATORIES

A. Laboratories shall not be authorized to release, revoke, alter or enlarge on requirements of contract documents; approve or accept any portion of work or perform any duties of Contractor or Architect.

1.07 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to work and operations.

B. Secure and deliver to laboratory adequate quantities of representational samples of materials proposed to be used which require testing.

C. Provide laboratory with preliminary design mix proposed to be used for concrete and other materials mixes which require control by testing laboratory.

D. Furnish copies of manufacturer's test reports of products as required.

E. Furnish incidental labor and facilities as follows:
1. To provide access to work to be tested.
2. To obtain and handle samples at project site or at source of product to be tested.

1.08 SPECIAL INSPECTIONS

A. Special inspections shall be required in accordance with Chapter 17 of the Building Code. The general contractor shall be responsible for coordinating all inspections with relevant inspection agency.
1. Arkansas Special Inspections Guidelines and Special Inspection Forms, revised January 01, 2023, may be downloaded from the Structural Engineers Association of Arkansas website at www.seaoar.org/resources and comply with the 2021 AFPC (2021 IBC in conjunction with the State of Arkansas Amendments), hereafter referred to as the Building Code.

B. Special Inspector shall keep respective records of inspections. Inspection reports shall be submitted to the Building Official or Authority Having Jurisdiction (AHJ) and to the registered design professional in responsible charge.

C. Reports shall indicate that inspected work was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official (AHJ) and the registered design professional in responsible charge, prior to the completion of that phase of the work.

D. A final report of inspections documenting required Special Inspections, and correction of any discrepancies, shall be submitted to the Owner, Building Official (AHJ) and the registered design professional in responsible charge at the completion of respective portion(s) of the work.

1.09 HAZARDOUS MATERIAL ABATEMENT

A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

A. Upon completion of inspection, testing, sample taking and similar services performed on the work, repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Protect work exposed by or for testing activities and protect repaired work.

END OF SECTION 01 45 23

PART 1 - GENERAL

1.01 GENERAL SITE REQUIREMENTS

A. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways.

B. Ensure safe passage of persons around areas of construction. Conduct operations to prevent injury to adjacent buildings, structures, facilities and persons.

C. Erect temporary covered passageways as required by authorities having jurisdiction.

D. Provide dust-proof partitions if required. If not indicated on the drawings, provide dust-proof partitions as directed by the Architect to comply with applicable sections of the Life Safety Code.

E. Provide temporary enclosures at doors and other openings in walls as necessitated by weather conditions. Construct enclosures with fire retardant treated lumber. Tape joints and caulk to prevent dust and debris from migrating beyond construction areas. Maintain enclosures in good repair and remove when no longer needed.

F. Provide interior and exterior shoring, bracing or support as needed to prevent movement, settlement or collapse.

1.02 PROJECT SIGNS

A. Subject to prior approval of Owner as to size, design, type, location and to local regulations, Contractor and his subcontractors may erect temporary signs for purposes of identification and controlling traffic.

B. Additional banner signs with grommets may be provided by the Architect to be placed as directed. Signs shall be maintained throughout the project then returned to architect’s site representative or discarded.

C. Contractor shall furnish and erect temporary construction sign at job site and remove sign at end of construction period. Paint and letter as directed by Architect to identify project, Owner, Architect and Contractor. Refer to general sign drawing (s) following this Section for reference and to Section 01 21 00 - Allowances.

1.03 JOB OFFICES AND STORAGE

A. Contractor and his subcontractors shall maintain office and storage facilities on site as may be necessary. Locate so as to cause no interference with work to be performed on the site by Owner or with Owner's operations. Consult with Architect regarding locations. Office shall have as a minimum the following items:

1. Complete set of Construction Documents including all addenda and supplemental information.
2. Telephone and fax machine.
3. Layout and meeting space for Architects or Owners representative to use when visiting the site.
4. Complete job file with copies of all correspondence concerning the project.
5. Other standard office equipment as is normally required to operate a business.

B. Upon completion of project, or as directed by Architect, Contractor shall remove temporary structures and facilities from the site, same to become his property. Leave the premises in condition required by Contract.

1.04 SANITARY ARRANGEMENTS

A. Contractor, at beginning of Work, to provide on premises suitable temporary convenience and enclosure for use of workmen on job. Maintain in sanitary condition and remove at completion of Work or when directed by Architect.

1.05 TEMPORARY UTILITIES FOR CONSTRUCTION

A. Provide all gas and electric service for heating, cooling, lighting and power required for construction purposes.

B. Provide all water required for construction purposes. Run temporary lines and provide necessary standpipes.

C. Contractor to pay all utility charges until time of substantial completion.

1.06 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise directed. Allow other entities to use temporary services and facilities without cost, including, but not limited to Construction Coordinator, Design Professional, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water Service from Existing System: Water from Owner's existing water system is available for use with metering and with payment of use charges. Provide meter connections and extensions of services as required for construction operations.

1.07 TEMPORARY HEATING

A. Provide temporary heating, coverings and enclosures necessary to protect operations and materials against damage by dampness and cold, to dry out work, and facilitate completion of Work.

B. Maintain critical installation temperatures required in separate Sections of the Specifications. Repair or replace at no additional cost to Owner, any materials and work damaged by dampness, insufficient or abnormal heat.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 50 00

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PART 1 - GENERAL

1.01 SUMMARY OF WORK

A. Work shall consist of temporary and permanent storm water pollution prevention measures through the use of berms, sediment basins, sediment dams, fiberglass roving, filter fabric, silt fences, brush barriers, baled straw erosion checks, temporary flexible pipe slope drains and temporary seeding.

B. Temporary storm water pollution prevention measures shall be performed promptly when problem conditions exist or when storm water pollution problems are anticipated in certain areas to minimize soil erosion and siltation. Temporary measures shall be properly maintained until permanent control measures are functioning properly.

C. The Contractor shall comply with all Federal, State and local laws and regulations concerning controlling pollution of the environment. He shall take all necessary precautions to prevent pollution of streams, lakes, ponds and reservoirs with fuel, oils, bitumens, chemicals, soil sedimentation or other harmful materials, and to prevent pollution of the atmosphere from particulate gaseous matter.

1.02 RELATED SECTIONS

A. Section 31 00 00 - Earthwork.

B. Section 31 10 00 - Site Clearing.

C. Section 31 23 33 - Trenching and Backfilling.

D. Section 31 25 00 - Erosion and Sedimentation Control.

1.03 At the Preconstruction Conference, or prior to the start of applicable construction, the Contractor shall submit his schedule for the accomplishment of temporary and permanent storm water pollution control work as applicable for clearing and grubbing, trenching and backfill to the Owner and Engineer. The location of the project, nature of the soil, topographic features and proximity to watercourses shall be considered when imposing such limitations.

PART 2 - MATERIALS

2.01 SEED AND FERTILIZER

A. Refer to Section 32 92 19.

2.02 STRAW BALES

A. Straw shall be the threshed plant residue of oats, wheat, barley, rye or rice from which the grain has been removed.

2.03 FENCE OR WIRE FABRIC

A. The fence fabric shall be a commercial grade of woven wire fence fabric. The wire fabric shall be a welded wire fabric.

2.04 FILTER FABRIC OR SILT FENCING

A. Nonwoven polypropylene or polyester fabric.

B. Manufacturer: Typar 3401, Trevira S1115, or equal.

2.05 ACCESSORIES

A. Wood or steel stakes. If using steel stakes (rebar), stakes shall have safety caps meeting OSHA requirements.

B. Rectangular hay bales shall be secured with twine or nylon rope.

C. Filter fabric shall be supported by steel or wooden posts and backed with a woven wire fabric for support.

PART 3 - EXECUTION

3.01 PERMITTING

A. A Storm Water Pollution Prevention Plan **is** required since the area to be disturbed is **more than** one acre.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering.
   3. Installation.
   4. Cutting and patching.
   5. Coordination of Owner's portion of the Work.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.
   9. Correction of the Work.

B. Related Requirements:
   1. Section 01 11 00 "Summary of Work" for coordination of Work by various trades, and limits on use of Project site.
   2. Section 01 74 23 “Final Cleaning” for procedures and inspection prior to Final Cleaning.
   3. Section 01 78 00 “Closeout Submittals” for Project Record Documents and Owner-accepted deviations from indicated Work.
   4. Section 02 41 19 "Selective Structure Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Certified Surveys: Submit 2 copies signed by land surveyor.

B. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

1.4 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
   4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. All cleaning agents used within animal habitats or animal holding areas must be approved by Owner and/or Zoo personnel, and must be fully neutralized upon use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
   4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 33 00 "Submittal and Substitution Procedures."

3.3 CONSTRUCTION LAYOUT

A. Electronic files of the Construction Documents may or may not represent accurate information. The use of electronic files and their accuracy for the construction and layout of the Project are the responsibility of the Contractor and must be approved by the Architect. Commencement of the Work will not be approved without a release of liability. All liabilities of using electronic files will be placed on the Contractor and the layout crew.

B. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

C. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify Architect prior to construction when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

D. Site Improvements: Locate and lay out site improvements, including, but not limited to, pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

E. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

F. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points. Replaced or relocated benchmarks must be approved by the Architect.

C. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
   4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated. Notify Architect when manufacturer’s information conflicts with the provided design information.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels. The Owner reserves the right to halt the use of any equipment, or Work, if it is impacting the animal welfare of the guest’s experiences. The duration of the halt will be at the discretion of the Owner, until an agreed upon schedule or additional accommodations are made.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

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

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 11 00 "Summary of Work."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
    a. Use containers intended for holding waste materials of type to be stored.
4. Obtain approved location from the Owner for holding waste and/or hazardous materials.
5. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."

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

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components as required and indicated in respective Sections.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

A. Section 01 11 00 - Summary of Work (Work by Owner or by separate Contractors)

B. Section 01 35 16 -Alteration Project Procedures: Cutting and patching for alterations work.

C. Section 01 33 00 - Submittal and Substitution Procedures

D. Individual Product Specification Sections:
   1. Cutting and patching incidental to work of the section.
   2. Advance notification to other sections of openings required in work of those sections.
   3. Limitations on cutting structural members.

1.03 SUBMITTALS

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

B. Include in request:
   1. Identification of Project.
   2. Location and description of affected Work.
   3. Necessity for cutting or alteration.
   4. Description of proposed Work and Products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on work of Owner or separate Contractor.
   7. Written permission of affected separate Contractor.
   8. Date and time work will be executed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Primary Products: Those required for original installation.

B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 33 00.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

B. After uncovering existing Work, assess conditions affecting performance of work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

B. Provide protection from elements for areas which may be exposed by uncovering work.

C. Maintain excavations free of water.

3.03 CUTTING

A. Execute cutting and fitting including excavation and fill if required, to complete the Work.

B. Remove and replace defective or nonconforming work.

C. Remove samples of installed work for testing when requested.

D. Provide openings in the Work for penetration of mechanical and electrical work.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.04 PATCHING

A. Execute patching to complement adjacent Work. Match with existing finish where exposed to view unless noted otherwise.

B. Fit Products together to integrate with other Work.

C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

D. Employ skilled and experienced installer to perform patching for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Restore work with new Products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material in accordance with Section 07 84 00 to full thickness of the penetrated element.

H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION 01 73 29

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PART 1 - GENERAL

1.01 CLEANING AND WASTE REMOVAL

A. Progress Cleaning:
   1. The premises and the job site shall be maintained in a reasonable neat and orderly condition and kept free from accumulations of waste materials and rubbish during the entire construction period. Remove crates, cartons, and other flammable waste materials or trash from the work areas at the end of each working day. Do not allow debris to blow onto adjoining properties. Respond immediately to request from adjoining property owners to remove any debris that does manage to show up on adjoining properties. Collect and remove waste materials, debris, and rubbish from site weekly, daily if necessary and dispose off-site.
   2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
   3. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

B. Final Cleaning:
   1. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.
   2. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's published instructions.
   3. Complete following cleaning operations before requesting inspection for Substantial Completion, where applicable to project scope:
      a. Clean Project Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains, and other foreign deposits. Rake grounds to a smooth even-textured surface.
      b. Remove tools, construction equipment, machinery, and surplus material from Project Site.
      c. Remove snow and ice to provide safe access to building.
      d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      f. Broom clean concrete floors in unoccupied spaces.

g. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.

h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped, scratched, or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces. Do not use razor blades to clean glass. Any scratches on the glass caused by the cleaning process will be cause for the removal and replacement of the damaged glass at the Contractor's expense.

i. Remove labels that are not permanent labels.

j. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.

k. Wipe surfaces of mechanical and electrical equipment, and other similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.

l. Plumbing fixtures are to be cleaned to a sanitary condition, free of stains, including stains resulting from water exposure.

m. Replace all disposable filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated without filters during construction.

n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned out bulbs, and defective and noisy starters in fluorescent and mercury vapor fixtures.

o. Leave Project clean and ready for occupancy.

4. Engage an experienced licensed exterminator to make a final inspection, and rid Project of rodents, insects, and other pests. Comply with regulations of local authorities having jurisdiction.

5. Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction.

6. Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from Project Site and dispose of in accordance with requirements of local authorities having jurisdiction.

   a. Extra materials of value that remain after completion of construction and have become the Owner's property are to be stored as directed by Owner.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 01 74 23

PART 1 - GENERAL

1.01 DESCRIPTION

A. Upon completion of Work and prior to final payment, a digital electronic copy of the following items must be submitted to Architect, tabbed and with a Table of Contents conforming to the current version of the CSI MasterFormat. Formatted items may be submitted on a thumb drive or via Microsoft OneDrive file hosting service (OneDrive also works as the storage backend of the web version of Microsoft 365 / Office cloud storage):

BELOW IS FOR DBA AND OTHERS WHO MAY REQUIRE CD/DVD I/L/O A THUMB DRIVE

A. Upon completion of Work and **prior to final payment**, **two (2) copies** of the following items must be submitted to Architect **in three-ring binders, tabbed and with a Table of Contents conforming to the current version of the CSI MasterFormat, including a readable CD/DVD format with digital copy of contents:**

1. General Contractors letter of warranty
2. General Contractors letter stating that all deficiency list items are complete
3. Lien releases
4. Consent of Surety to pay final retainage
5. List of all subcontractors and suppliers, including portions of the work performed, address and telephone number of firm, and a contact name familiar with the project. Two (2) copies. One copy in each binder.
6. Guarantees and Warranties: Refer to specific sections of Project Manual for general requirements on warranties, product/workmanship bonds, and maintenance agreements. Furnish two (2) fully executed copies of each guarantee and warranty specified for review by Architect, one copy in each binder.
7. Certificates: Fully executed copy of each certificate specified, where applicable:
   a. Certificate of Occupancy
   b. Final Termite Inspection
   c. Final Plumbing Inspection
   d. Final Electrical Inspection
   e. Certificate of Air Balance
8. Miscellaneous other inspection reports, where applicable:
   a. Boiler and Tank
   b. Elevators and Hoist Systems
   c. Backflow Preventers on Potable Water
   d. Fire Suppression System
   e. Fire Alarm System
   f. Security System
   g. Backup Power Generator
   h. Cable Test/Certification Reports and Startup Records
9. Instructions: Operating, service and maintenance manual or instruction sheet for each item as requested by specifications and required for Owner's use.
10. Building hardware packet as described in Section 08 71 00, if applicable.

11. Shop Drawings: A complete file of final copies of all shop drawings used in construction of project.
12. Complete set of all submittals for products used in construction of project.

B. Project Record Drawings: The Contractor shall provide one (1) complete set of project record drawings and two (2) CD's of scanned images of the drawings.
1. Cloud and reference each of the following items on the Record Drawings:
   a. written addendum items
   b. addendum drawings
   c. "X" drawings
   d. Supplemental Instructions
   e. Change Orders
   f. responses to RFI's
   g. any other deviations from the original drawings that are made in the field
2. Record final locations of underground lines by depth from finished grade and by accurate horizontal offset distances to permanent surface improvements such as buildings, curbs, edges, or walks.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.01 EXTENDED WARRANTIES

A. The entire project is warranted for a period of one (1) year from the date of substantial completion and several materials and systems require extended warranties. It is the responsibility of the General Contractor to review the Project Manual to determine the term of the extended warranties and provide the extended warranties required.

END OF SECTION 01 78 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Site preparation includes, but is not necessarily limited to:
1. Temporary fencing and protective barricades, including construction fencing.
2. Protection of trees and shrubs to remain.
3. Felling of trees removed, removal of stumps, roots and debris from Work.
4. Removal of obstructions which interfere with Work.
5. Stripping of topsoil and vegetation from earth areas of site.
6. Removal of concrete and removal of asphaltic concrete pavement.
7. Abandonment and capping wells or cisterns.
8. Demolition and removal of buildings or building elements.
9. Protection of active utilities and removal of utilities abandoned.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Workmen Qualifications: One person present during tree clearing and grubbing operations, thoroughly familiar with types of trees involved. Direct trimming of roots and limbs where required.

B. Codes and Standards: Comply with pertinent codes and regulations, plus requirements of insurance carriers providing coverage for Work.

1.05 JOB CONDITIONS

A. Dust Control: Prevent spread of dust during performance of Work. Thoroughly moisten surfaces required to prevent dust nuisance to public, neighbors, and concurrent performance of other work on site.

B. On-site Burning: Will not be permitted.

C. Protection: Protect existing objects not to be removed. In event of damage, immediately make repairs and replacements necessary to approval of Architect at Contractor's expense.

1.06 HAZARDOUS MATERIAL ABATEMENT

A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS

2.01 BARRICADES AND FENCE MATERIALS

A. Materials required for barricades, tree protection and related fencing furnished by Contractor.

2.02 FILL MATERIAL

A. Refer to Section 31 00 10, if applicable.

PART 3 - EXECUTION

3.01 PREPARATION

A. Notification: Notify Architect at least two full working days prior to commencing work.

B. Site Inspection:
1. Prior to work of this Section, carefully inspect entire site and objects designated to be removed or preserved.
2. Locate existing utility lines to be abandoned and determine requirements for disconnecting and capping.
3. Locate existing active utility lines which are to remain and determine requirements for their protection.

C. Clarification:
1. Drawings do not purport to show all objects existing on site.
2. Before commencing work of this Section, verify with Architect all objects to be removed and all objects to be preserved.

D. Scheduling:
1. Schedule work in a careful manner with necessary consideration for neighbors and public.

2. Avoid interference with use of, and passage to and from, adjacent buildings and facilities.

3.02 DISCONNECTION OF UTILITIES

A. Before commencing demolition or removal, and if not already accomplished, disconnect or arrange for disconnection of utility service connections, including water, gas, electricity, and telephone, to buildings to be demolished complying with regulations of utility concerned. Plug sanitary sewer lines in accordance with local requirements. Conduct operations at Contractor's expense and in manner to preserve service to areas and structures not demolished. If underground utility services disconnections are required in public thorough-fares, comply with removal and restoration of pavement requirements and other pertinent matters.

B. Preserve in operating condition active utilities bordering or traversing site designated to remain. Protect property, including, but not limited to, valve boxes, poles, guys and related appurtenances. Repair damage to active utility, due to work under contract, to satisfaction of utility concerned. Remove utility lines that are to be abandoned from building area.

3.03 STRIPPING TOPSOIL

A. Remove existing grass and overburden before excavating topsoil.

B. Prior to beginning excavation or fill, strip the topsoil to a depth of at least 6 inches or to a depth sufficient to remove all organic material and stockpile for future use.

C. In general, remove topsoil where structures are to be built, trenches dug and roads, parking lots, walks and similar improvements constructed within the areas presently covered with topsoil.

D. Store topsoil clear of the construction area.

E. Take reasonable care to prevent the topsoil from becoming mixed with subsoil or eroding.

3.04 DEMOLITION OF STRUCTURES

A. Demolish buildings and/or building elements designated for demolition, pulling out foundations and concrete slabs. Completely remove designated building components and any obstructions above ground level and down to bottom of footings below ground level. Salvageable materials become property of Contractor unless otherwise shown or specified and shall be promptly removed from site.

B. Fill holes and trenches resulting from demolition and removal, to ground surface. Rock and materials from masonry construction may be used in backfilling up to a depth of 1 foot below ground surface if sufficient fine materials are mixed therewith to fill voids. Use dirt for top 1 foot of fill, free from trash, wood, pipe and debris.

C. After clearing, perform rough grading necessary to provide complete run-off of surface water.

D. Barricade open excavations until backfilled. Do not backfill until backfill materials have been inspected and approved by Architect's representative.

E. Wet down masonry thoroughly during demolition to prevent spread of dust.

F. Leave parcel site in safe and clean condition, free from rubbish, debris, materials, and equipment.

G. When Contractor starts building demolition, excluding interior striping of salvable items including plumbing and electrical fixtures, he is to continue work during normal working days suitable to operations until demolition and site clearance is completed, unless otherwise specifically authorized by Owner.

3.05 PROTECTION AND REPAIR

A. Erect temporary barricades and fencing required to protect existing and new site construction including but not limited to new and existing walks, drives, roads, curb and gutter, etc. during construction.

B. Allow no heavy traffic on new or existing paving unless authorized in writing by Owner.

C. Contractor is responsible for restoring all existing site construction, including softscape (landscape), that is damaged during construction to new condition.

D. If it is necessary to cut or trench across any existing paving (including walks), Contractor is responsible for restoring damaged areas to new condition.

3.06 PROTECTION OF TREES TO REMAIN

A. At trees to remain, construct temporary barricade around tree at tree's approximate drip line. Provide barricades at least 3 feet high, consisting of 2 inch by 4 inch or larger posts set at least 18 inches into ground, no more than 6 feet on centers, joined at top by 1 inch by 6 inch or larger boards firmly nailed to posts.

B. Trimming of Trees: In company with Architect, ascertain limbs and roots which are to be trimmed and clearly mark them to designate approved cutting point. Cut evenly, using proper tools and skilled workmen to achieve neat severance with least possible damage to tree. Promptly coat cut area with approved pruning paint complying with manufacturer's recommendations. In case of root cuts, apply wet burlap or related protection approved by Architect, to prevent drying out.

3.07 TREE/BRUSH REMOVAL

A. Remove trees, brush and vegetation except trees which are to remain, from Project site. Material resulting from clearing becomes property of Contractor, who shall be responsible for disposal.

B. Wet down areas where required during site clearing to prevent spread of dust.

C. Blasting on Project site is not allowed as a means of tree removal.

3.08 STUMPS AND ROOTS

A. Remove completely stumps and roots from areas within building walls and 5 feet outside building walls. Remove remaining stumps and roots to clear depth of not less than 2 feet below subgrade level. Material resulting from grubbing becomes property of Contractor, to dispose of by him. Burn no material on premises.

3.09 OBSTRUCTIONS

A. Remove existing obstructions from area to be occupied by Work under this Contract unless otherwise specified herein, or specifically directed by Architect to remain.

3.10 REMOVAL OF DEBRIS AND CLEANING

A. Remove and legally dispose of rubbish and debris found on demolition area at start of the Work that resulting from demolition activities or deposited on site by others during the duration of contract. Keep project area and public right-of-way reasonably clear at all times. Upon completion of work remove temporary construction, equipment, salvaged materials, trash and debris leaving entire project area in neat condition.

END OF SECTION 02 41 13

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Demolition and removal work required for construction and connecting new Work to existing building and for remodeling **[reconstructing]** existing building. Work also includes barricades, temporary protection, dust protection, removal from site trash and debris from demolition work, and repairing existing hardscape/softscape damaged during the course of the work.

B. Extent of selective demolition work is generally indicated on drawings. Selective demolition not shown on the drawings may be determined by examination of existing facilities and the proposed new and remodeled **[reconstructed]** work. Existing items not shown on the plans of proposed work and preventing the execution of proposed work are in the scope of the selective demolition work.

C. Refer to the mechanical and electrical and plumbing drawings for extent of demolition work required in adjacent areas for accommodation of renovation work. If no drawings show the extent of demolition, the Contractor must determine the extent of work and include it in his scope of work.

D. Degree of patching to be performed in a given area will be determined by the proposed new finish of that area.

E. Disconnecting, removal and/or relocation and reconnecting of existing mechanical, electrical and fire protection work including equipment, piping and wiring are included in this Contract.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SCHEDULES

A. Before commencing any alteration work, submit for review and approval of the Architect, a schedule showing the commencement, the order, and the completion dates for the various parts of this work.

B. Before starting any work relating to existing utilities that will temporarily discontinue service to the existing building, notify the Owner 5 days in advance and obtain the Owner's approval before proceeding with this phase of work. Do not disconnect or disrupt service without Owner's prior approval.

1.04 HAZARDOUS MATERIAL ABATEMENT

A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS

2.01 BARRICADE AND SUPPORT MATERIALS

A. Before starting demolition and removal work, furnish and erect necessary barricades. Barricades shall provide for safe passage at all times. Provide temporary protection to keep existing building weathertight. Dust proof areas that are to be kept in use in manner to permit necessary passage for personnel and the protection of equipment. During process of demolition and removal, install temporary supports and bracing, to prevent building damage.

B. If approved by Architect, materials from demolition work may be used for construction of temporary protective barricades, temporary partitions, noise barriers and dust barriers and for temporary non-structural supports. Where suitable materials are not available from demolition work, furnish materials of proper type and construction to perform function specified above.

2.02 OTHER MATERIALS

A. Provide materials, not specifically described but required for proper completion of work of this Section, selected by Contractor subject to Architect's approval.

PART 3 - EXECUTION

3.01 PREPARATION

A. Make such explorations and probes as are necessary to ascertain required protection measures before proceeding with alteration work. Give particular attention to shoring and bracing requirements so as to prevent any damage to existing construction.

B. Provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the workmen engaged in alteration operations, and adjacent construction.

C. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

D. Provide and maintain temporary protection of the existing building where demolition, removal, and new work is being done, connections made, materials handled, or equipment moved.

E. Take necessary precautions to prevent dust and dirt from rising by wetting demolished masonry, concrete, plaster, gypsum board, sprayed fireproofing and similar debris, or by other means. Protect unaltered portions of the existing building affected by the operations under this section by dust-proof partitions and other adequate means.

F. Do not close or obstruct walkways or passageways without the authorization of the Owner. Do not store or place materials in passage-way or other means of egress. Conduct operations with minimum traffic interference.

G. Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.

3.02 UTILITY SERVICE

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services such as emergency power, fire alarm, heating and air conditioning, during interruptions to existing utilities, as acceptable to Owner and governing authorities. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.

C. Disconnect and seal utilities serving interior area to be demolished, prior to start of demolished work.

D. Protect smoke and fire detectors from construction damage, dust and false alarms.

E. Request Owner to identify any data/communication wiring above the ceiling that should be removed. Remove this wiring.

F. Remove all abandoned conduit and wiring above ceiling.

3.03 INSTALLATION/APPLICATION/PERFORMANCE

A. Provide alteration work as indicated on the drawings or required for the work of this Contract. Be responsible for any damage that may be caused by such work to any part or parts of existing structures or items designated for reuse or salvage. Perform patching, restoration, and new work in accordance with applicable technical sections of the Specifications.

B. Where alterations occur, or new and old work join, cut, remove, patch, repair, or refinish the adjacent surfaces or as required by the involved conditions, and leave in as good a condition as existed prior to the commencing of the work. Refinish painted surfaces from intersection to intersection unless indicated otherwise. Materials and workmanship employed in the alterations, unless otherwise indicated or specified, shall conform to that of the original work. Materials not specifically described but required for a complete and proper installation of the work, shall be new, first quality of their respective kinds, as selected by Contractor subject to the approval of the Architect. Alteration work shall be performed by the various respective trades that normally perform the particular items of work.

C. Finish new and adjacent existing surfaces as specified for new work. Clean existing surfaces of dirt, grease and loose paint before refinishing.

D. Where alterations occur in areas to be completed during later phases of the work only prepare adjacent surfaces as necessary and complete finishing during proper phase of the work.

E. If it will be necessary to disrupt internal pedestrian traffic flow along means of egress from the building, the Contractor must consult the presiding code official in regards to temporary means of egress, temporary exit signage and other related items. Implementation of requirements made by the code official are the responsibility of the Contractor.

F. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written, accurate detail. Pending receipt of directive from Owner's Representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.04 SALVAGE

A. Certain items and materials removed from existing building in demolition work are to be relocated or reused by Contractor in new construction work under this Contract. Items and materials for relocation or reuse and which are damaged by careless handling in removal may be rejected by Architect if considered unsuitable for re-use. Replace rejected items at Contractor's expense. Salvable materials, removed in demolition work and not for relocation or re-use or not turned over to the Owner for disposition, become property of Contractor and shall be hauled away from site as they are removed.

B. In all cases of interior demolition, door hardware, light fixtures, emergency lighting, art work, furniture, window treatments such as blinds, drapes, curtains and operating hardware, signage and graphics and other interior decor items are to be carefully removed and turned over to Owner unless designated to be cleaned or refurbished and reinstalled.

3.05 REMOVAL OF DEBRIS AND CLEANING

A. Remove and legally dispose of rubbish and debris found in demolition area at start of the Work that resulted from demolition activities or were deposited on site by others during the duration of contract. Keep project area and public right-of-way reasonably clear at all times. Upon completion of work remove temporary construction, equipment, salvaged materials, trash and debris leaving entire project area in a neat and clean condition.

3.06 PROTECTION AND REPAIR

A. Erect temporary barricades and fencing required to protect existing and new site construction including but not limited to new and existing walks, drives, roads, curb and gutter, etc. during construction activities.

B. Allow no heavy traffic on new or existing paving unless authorized in writing by Owner.

C. Contractor is responsible for restoring all existing site construction, including softscape (landscape) and hardscape, that is damaged during construction to new condition.

D. If it is necessary to cut or trench across any existing paving (including walks), Contractor is responsible for restoring damaged areas to new condition.

END OF SECTION 02 41 19

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparation of existing concrete surfaces and application of repair materials.

B. Rehabilitation of concrete surfaces.

C. Repair of cracks and holes in concrete surfaces.

1.02 RELATED SECTION

A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
   2. ASTM D4259 - Standard Practice for Abrading Concrete.
   3. ASTM D4260 - Standard Practice for Acid Etching Concrete.
   4. ASTM D4261 - Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
   5. ASTM D4262 - Standard Practice for Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
   6. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

1.04 SUBMITTALS

A. Submit product data under provisions of Specifications.

B. Submit product data indicating product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions and general recommendations regarding each material.

C. Submit manufacturer's installation instructions under provisions of Specifications.

D. Submit manufacturer's certificate under provisions of Specifications that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Materials Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in concrete repair with minimum two years experience.

C. Representative of the manufacturer, familiar with the products specified shall be available at job site at initial starting of repair work and at intervals during surface preparation and repair as may be required for product application quality assurance, to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

D. Inform Engineer a minimum of 3 days in advance of the start of surface preparation work or repair work. Work shall be performed only in the presence of Engineer, unless Engineer has granted prior approval to perform work in his absences.

E. For repairs subject to immersion, full cure must be obtained for the completed system. Consult coating manufacturer's written instructions for these requirements. Coating shall not be immersed for any purpose until completion of the curing cycle.

F. Inspection by Engineer, or waiver of inspection of any particular portion of the Work, shall not be construed to relieve Contractor of his responsibility to perform the Work in accordance with these Specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products to site under provisions of Specifications.

B. Comply with manufacturer’s instruction for storage, shelf life limitations, and handling.

PART 2 - PRODUCTS

2.01 WATERPROOFING MATERIAL

A. Cement-based, aggregate type, heavy-duty, waterproof coating for concrete and masonry.

B. Thoro System Products, Thoroseal.

C. Or equal.

2.02 PATCHING MATERIAL

A. A two-component, cement-based, acrylic polymer patching compound.

B. Thoro System Products, Thoropatch.

C. Master Builders, Inc., Masterpatch 210.

D. Or equal.

2.03 CRACK REPAIR MATERIAL

A. A cement-based, quick set, repair mortar.

B. Thoro System Products, Waterplug.

C. Or equal.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Clean concrete surfaces of dirt, laitance, corrosion, or other contamination by one of the methods described in ASTM D4258.
   1. Rinse surface and allow to dry.
   2. Where determined necessary by the Engineer concrete shall be mechanically abraded by one the methods of ASTM D4259 or chemically etched by the method of ASTM D4260.

B. For areas to be patched with a two-component, cement-based, acrylic polymer patching compound:
   1. Chip out all loose and disintegrated concrete.
   2. Clean off all oils, grease, dirt, salt deposits, etc.
   3. Prepare a clean, sound surface; flush clean; let dry.

C. For cracks and holes to be repaired with a cement-based, quick-set, repair mortar:
   1. Flush out with water to remove laitance and dirt.
   2. Cut out crack or hole to a minimum depth and width of 3/4-inch.
   3. Undercut if possible.

3.02 INSTALLATION

A. Apply materials following manufacturer's recommendation and instructions. Test for moisture and pH prior to application in accordance with ASTM D4262 and D4263 respectively as directed by Engineer or manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Form cast-in-place concrete required and subsequently remove forms except as otherwise specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Qualifications of Workmen: Provide foreman at all times during execution of this portion of the Work, thoroughly familiar with type materials being installed, referenced standards, and requirements of this work, and who shall direct work performed under this Section.

B. Codes and Standards:
   1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations contained in "Recommended Practice for Concrete Formwork", publication ACI 347 of the American Concrete Institute.
   2. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.

PART 2 - PRODUCTS

2.01 WOOD FORM MATERIALS

A. Form Lumber: Provide form lumber in contact with exposed concrete using new material except as allowed for re-use of forms. Provide form lumber as follows, a combination thereof, or an equal approved in advance by Architect:
   1. "Plyform", class I or II, bearing label of the American Plywood Association.

2. Southern Pine or Douglas Fir, number 2 grade, seasoned, surfaced 4 sides.

B. Form Sealers: Provide "React S" by Conspec, or approved equal.

2.02 TIES AND SPREADERS

A. Type: Type which does not leave an open hole through concrete and which permits neat and solid patching at every hole.

B. Design: Metal not less than one inch from surface at completion of concrete work.

2.03 EXPANSION JOINTS

A. Non-extruding, pre-moulded filler strips conforming to ASTM D 1751 or D 1752 and compatible with sealant material used to seal joints.

2.04 FORMED JOINTS

A. Non-staining materials; of wood, plastic, or metals, formed to be removed without spalling concrete.

2.05 KEYED JOINTS

A. KEY-LOK® by Form-A-Key Products, BoMetals QuicKey by White Cap, Muller Construction Co. or approved equal. Top of stakes set 3/8" below slab surface so when joint form is placed on stakes, painted portion of joint is finished elevation. Finish concrete to top of joint and burn in with hand trowel.

2.06 WATERSTOPS

A. Provide waterstops using extruded rubber, rubber compound or polyvinyl chloride. Furnish material with cross section of dumbbell, (bulbed), (ribbed), or otherwise deformed to prevent movement. Furnish material resistant to acid, alkali solution, and deterioration.

B. Hydrophilic Strip Waterstop: Provide WATERSTOP-RX® Expanding Concrete Joint Waterstop as manufactured by CETCO, 800-527-9948 or approved equal product. Install per manufacturer’s published recommendations, including accessory products required for a complete installation.

2.07 OTHER MATERIALS

A. Provide materials, not specifically described but required for completion of concrete formwork as selected by Contractor subject to advance approval of Architect.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF FORMS

A. General: Construct substantial, sufficiently tight forms to prevent fins and leakage of mortar, and able to withstand deflection when filled with wet concrete.

B. Layout:
   1. Form cast-in-place concrete to shapes, sizes, lines, and dimensions required.
   2. Exercise particular care in form layout to avoid necessity for cutting of concrete after placement.
   3. Make proper provision for inserts, sleeves, pipes, openings, offsets, recesses, anchorage, blocking, and related features as required.

C. Forms for footings and related below grade concrete may be omitted when soil and workmanship permit accurate excavation to size and where omission is approved by Architect.

D. Removal of forms: Time for removing forms is subject to weather conditions after concrete is poured. Remove form work in manner to insure complete safety of structure. Do not place building materials on slabs until they are strong enough to carry the imposed load. Contractor shall decide when to remove forms and accept full responsibility for their removal.

3.02 JOINTS

A. If proposed layout of joints differs from layout shown on drawings, Contractor shall submit three (3) copies of alternate layout plan to Architect for review. Do not proceed with alternate layout of joints without written approval from Architect.

B. Provide mechanical "Keyed Kold" joint screed forms used in placing concrete slabs on grade installed to comply with manufacturer's specifications.

C. Construction Joints: Where joint is made, thoroughly clean concrete surface and remove all latence. In addition, thoroughly wet and slush vertical joints with a coat of neat cement grout immediately before placing new concrete.

D. Expansion Joints: Do not run reinforcement, corner protection angles, or related fixed metal items, embedded in or bonded into concrete continuous through expansion joints. Provide filler strips for expansion joints between slabs on grade and all joints between slabs on grade and vertical surfaces. Construct joints 1/2-inch thick and full depth of slab, unless otherwise noted.

E. Saw-cut Control Joints: In "Green" concrete the following tables will apply.
   1. Depth of cut:
      a. Soff-Cut Saw: 1" minimum
      b. Wet-Cut Saw: 1/4 slab thickness

2. Joint spacing based upon slab thickness, UNLESS NOTED OTHERWISE:
    a. 4" slab equals 10'-0" o.c.
    b. 5" slab equals 13'-0" o.c.
    c. 6" or thicker slab equals 15'-0" o.c.

3.03 RUBBED SURFACES

A. Construct forms for exposed cast-in-place concrete with smooth exterior grade plywood or steel with joints butted tight to prevent fins and leaking. As soon as forms are stripped, rub down concrete surface with carborundum grinders using water and Portland cement as rubbing agent. Rub exposed concrete until a uniformly even surface is obtained, with no joint marks or defects showing. Do not apply neat cement or grout to concrete as painted or plastered finish coat.

3.04 JOINT-FREE SURFACES

A. No joint allowed in formed surfaces where joint-free surfaces are required. In forming for joint-free surfaces, use metal lined forms and cover form joints with form tape.

3.05 CHAMFERED CORNERS

A. Chamfer corners of rectangular concrete members formed with wood forms except where flush with adjacent concrete or masonry, or where covered with other materials.

END OF SECTION 03 10 00

PART 1 - GENERAL

1.01 SUMMARY

A. Provide expansion, construction, and contraction joints as specified.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM A36 - Specification for Structural Steel.
   2. ASTM D226 - Specification for Asphalt-Saturated Organic Felt used in Roofing and Waterproofing.
   3. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   4. ASTM D1190 - Specification for Concrete joint Sealer, Hot-Poured Elastic Type.
   5. ASTM D1751 - Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

B. Corp of Engineers, (U.S. Department of the Army) Pulaski Building, 20 Massachusetts Avenue, North West, Washington, D.C. 20314.
   1. CRD-C-572 - Polyvinylchloride Waterstops.

C. Federal Specifications: SS-S-210A; Sealing Compound for Expansion Joints.

PART 2 - PRODUCTS

2.01 WATERSTOPS

A. Center bulb type extruded from an elastomeric plastic compound, the basic resin of virgin polyvinyl chloride (PVC).

B. Size as recommended by manufacturer for each application or as shown on Drawing. Generally 6 inches for walls with a 12 inches thickness and 9 inches for walls thicker than 12 inches.

C. Specific gravity approximately 1.37 and the shore durometer Type A hardness, approximately 80.

D. Meet the performance requirements of the Corps of Engineers' Specification CRD-C-572.

E. Constant thickness from the edge of the bulb to the outside edge.

F. Have a number of parallel ribs or protrusions on each side of the center of the strip.

G. Corrugated type or tapered waterstops are not acceptable.

H. The minimum weight per foot for waterstop shall be 0.75 pound for 3/16-inch by 6-inch, 1.35 pounds for 3/8-inch by 6-inch, and 2.05 pounds for 3/8-inch by 9-inch.

I. Manufacturers:
   1. Southern Metal and Plastic Products, Inc.
      a. Type 11RCB for 4-inch by 3/16-inch.
      b. Type 17RCB for 6-inch by 3/8-inch.
      c. Type 18RCB for 9-inch by 3/8-inch.
   2. Vinylex Corporation.
      a. Catalog No. RB6-38H for the 6-inch by 3/8-inch.
      b. Catalog No. RB9-38H for the 9-inch by 3/8-inch.
   3. Greenstreak Plastic Products.
      a. Style 732 for the 6-inch by 3/8-inch.
      b. Style 735 for the 9-inch by 3/8-inch.
   4. Or approved equal.

2.02 BOND BREAKER TAPE FOR EXPANSION JOINTS

A. Where indicated, adhesive-backed glazed butyl or polyethylene tape that will satisfactorily adhere to the premolded joint material or concrete surface.

B. Same width as joint.

2.03 PREMOLDED JOINT FILLER - BITUMINOUS TYPE

A. Bituminous type conforming to ASTM D994 or D1751, unless otherwise shown or specified.

B. Use around pipe penetrations through existing walls.

C. Manufacturers:
   1. Synko Flex Products Inc.; Synko Flex Preformed Plastic Adhesive Waterstop.
   2. American Colloid Co.; Waterstop RX.

2.04 BOND BREAKER

A. Bond breaker, except where a tape is specifically called for, shall be either bond breaker tape as specified or a bond prevention material, nonstaining type, as specified in Section 03 30 00.

2.05 CORK EXPANSION JOINT FILLER

A. Manufacturer: W.R. Meadows Sealtight, or equal.

B. Seal joints with a pourable two-component cold-applied compound to depth as indicated on Drawings.

2.06 POURABLE JOINT FILLERS - RUBBER ASPHALT FILLER

A. Hot-pour type, conforming to ASTM D1190. Use primer recommended by the manufacturer.

2.07 COAL-TAR TAPE

A. Manufacturer's:
   1. Protecto Wrap 200, by Protecto Wrap Co., Denver, CO.
   2. Tapecoat CT, by Tapecoat Company, Inc., Evanston, IL.
   3. Or equal.

2.08 STEEL EXPANSION JOINT DOWELS

A. Smooth steel conforming to ASTM A36. Coating on bars with an approved, FUSION BONDED COATING.

PART 3 - EXECUTION

3.01 INSTALLATION OF WATERSTOPS - GENERAL

A. Join waterstops at intersections so continuous seal is provided.

B. Center waterstop on joint.

C. Hold waterstop positively in correct position.

D. If waterstop is damaged, repair in acceptable manner.

E. Vibrate concrete to obtain impervious concrete in the vicinity of joints.

F. In horizontal joints, fill areas below waterstop completely with concrete; make visual inspection of entire waterstop area during concrete placement.

3.02 WATERSTOPS IN CONSTRUCTION JOINTS

A. Horizontal Waterstops:
   1. Place immediately after the pour is completed and before concrete has begun to set.
   2. Puddle each side to level concrete and assure that waterstop is properly embedded.
   3. Where stops are spliced, lap at least 12 inches and secure together.
   4. After concrete has set to the point where the surface can be cut with a broom or a stream of water, cut off the surface to a rough finish with laitance removed and the concrete left clean.

B. Vertical Waterstop: Place and secure in forms prior to placing concrete.

3.03 PLASTIC WATERSTOP

A. Install in accordance with details shown and manufacturer's instructions.

B. Allow at least 10 minutes before pulling or straining the new splice.

C. Finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80 percent of unspliced materials.

3.04 SPLICES AND JOINTS

A. Prior to use of the waterstop material in the field, submit a sample of a fabricated cross constructed of each size or shape of material to be used for approval.

B. Fabricate samples so that the material and workmanship represent the fittings provided under this Section.

C. Make field splices and joints in accordance with waterstop manufacturer's instructions using a thermostatically controlled heating iron.

3.05 JOINT PREPARATION - GENERAL

A. Accurately locate and construct joints to produce straight joints.

B. Vertical or horizontal, except where walls intersect sloping floors.

C. Do not commence concrete pour until after joint preparation has been inspected and approved by Engineer.

3.06 CONSTRUCTION JOINTS

A. Prior to placing abutting concrete, clean contact surface by sandblasting or other approved means to remove laitance and expose the aggregate.

B. Remove concrete from exposed portion of reinforcing steel.

C. Do not damage the waterstop, if one is present, during the cleaning process.

D. Grout for horizontal construction joints shall be as specified in Section 03 30 00.

E. Roughen surface of hardened concrete by one of the following methods:
   1. Sandblast foundation and reinforcing dowels after concrete has fully cured to remove laitance and spillage and to expose sound aggregate.
   2. Water blast the foundation and reinforcing dowels after concrete has partially cured to remove laitance and spillage and to expose sound aggregate.
   3. Green cut fresh concrete with high pressure water and hand tools to remove laitance and spillage from the foundation and reinforcing dowels, and to expose sound aggregate.

3.07 LOCATION

A. Joints as shown on the Drawings or approved by Engineer.

3.08 TIME BETWEEN POURS

A. At least 2 hours shall elapse after depositing concrete in long or high columns or heavy walls before depositing in beams, girders, or slabs supported thereon.

B. For short columns and low height walls, 10 feet or less, wait at least 45 minutes prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

C. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.

D. Where cold joints will result and this joint will be below the finished water surface, provide and install a waterstop in the joint.

3.09 EXPANSION JOINTS - GENERAL

A. Provide premolded joint filler of sufficient width to completely fill the joint space.

B. If a waterstop is in the joint, accurately cut premolded joint filler to butt tightly against the waterstop and the side forms.

C. At locations where joint sealant is to be applied, precut premolded joint filler the required depth.

D. Form cavities for joint sealant with either precut, premolded joint filler or smooth, accurately-shaped material that can be removed.

E. Thoroughly vibrated concrete along the joint form to produce a dense, smooth surface.

F. Repair surface irregularities along the joint sealant cavity due to improper concrete consolidation or faulty form removal with an approved compound compatible with the joint sealant in a manner that is satisfactory to the sealant manufacturer.

3.10 INSTALLATION OF BITUMINOUS TYPE OR CLOSED CELL FOAM TYPE PREMOLDED JOINT FILLER

A. Drive nails at about 1 foot on centers through the filler to provide anchors into the concrete when it is placed.

B. Place premolded joint filler in the forms in the proper position before concrete is poured.

C. Install premolded joint filler in walks (to provide expansion and contraction joints at not more than 20-foot intervals), at changes in direction at intersections, and at each side of driveway entrances.

3.11 POURABLE JOINT FILLER - GENERAL

A. Install pourable joint fillers in accordance with the manufacturer's instructions.

B. Thoroughly clean joints by sandblasting concrete surfaces of each side of joint from plastic waterstop to top of joint, dry the joint, and remove dust and foreign material; prime before pouring the filler.

C. Avoid damaging waterstop by sandblasting operations.

D. Primer compatible with filler material.

3.12 RUBBER ASPHALT JOINT FILLER

A. Heat rubber asphalt filler material in a double-walled boiler and place in the joint by means of a nozzle.

B. Prevent spillage outside of the joint.

C. Begin pouring joint filler at the bottom of the horizontal joint and proceed upwards in a manner that will preclude the possibility of trapping air in the joint.

D. Use masking tape at each side of joint to assist in cleaning all spillage.

3.13 CONTROL JOINTS IN FLOOR SLABS

A. Form tongue-and-groove construction joints with keyway in bulkhead forms.

B. Key horizontal joints the full length of the member.

C. Key width shall occupy the interior one-third section, and depth of the key shall be 2 inches.

3.14 STEEL EXPANSION JOINT DOWELS

A. Install parallel to wall or slab face and in true horizontal position by securing tightly in forms with rigid ties.

B. Orient dowels to permit joint movement.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install reinforcement and associated items required for cast-in-place concrete.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.
   1. Furnish Shop Drawings for review by Architect, on reinforcing steel including special details, bending diagrams, schedules, bar lists, placing diagrams, and accessories. In addition to provisions in General Conditions, submit reinforcing Shop Drawings prepared by or under supervision of registered professional engineer. Reproduction (in any form) of Contract Drawings are not to be used for Shop Drawings. Furnish two prints and one sepia reproducible of Shop Drawings to Architect for review. Submit related shop drawings together. Partial submittals will not be accepted.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Qualifications of Workmen: Provide foreman at all times during execution of this portion of the Work, thoroughly familiar with type materials being installed, referenced standards, and requirements of this work, and who shall direct work performed under this Section.

B. Codes and Standards:
   1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations contained in "Manual of Standard Practice for Detailing Reinforced Concrete Structures", publication ACI 315 of the American Concrete Institute.
   2. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.

PART 2 - PRODUCTS

2.01 CONCRETE REINFORCEMENT

A. Concrete Reinforcement Materials: New, free from rust, and complying with following reference standards:
   1. Bars for Reinforcement: "Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A-615, grade 60 unless otherwise shown.
   2. Wire Fabric: ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI CODE-318 except as specified.

2.02 OTHER MATERIALS

A. Provide metal accessories, including spacers, chairs, ties, and devices necessary for properly assembling, placing, spacing, and supporting reinforcement (including welded wire fabric at 2" from top of slab) in place. Provide materials, not specifically described but required for complete and proper installation of concrete reinforcement, as selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 SITE CONDITIONS

A. Inspection:
   1. Carefully inspect installed work of other trades and verify work is complete to point where this installation may properly commence.
   2. Verify that concrete reinforcement may be installed to comply with pertinent codes and regulations, reviewed Shop Drawings, and original design.

B. Discrepancies:
   1. In event of discrepancy, immediately notify Architect.
   2. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 BENDING

A. General: Fabricate reinforcement to comply with reviewed Shop Drawings. Do not use bars with kinks and bends not shown on Drawings or on reviewed Shop Drawings. Do not bend and straighten steel in manner that will injure material.

B. Assembly: Tack-welding not acceptable for assembly of reinforcement without specific approval of the Structural Engineer. When permitted by Engineer all welding shall conform to reinforcing steel welding code (AWS D.12.1) of the American Welding Society.

3.03 PLACING OF REINFORCEMENT

A. Placing:
   1. Support and wire together reinforcing bars to prevent displacement by construction loads and placing of concrete. On ground and where necessary, supporting Normal Weight concrete blocks may be used. Provide at flat formwork, metal or plastic coated bar chairs and spacers. Provide galvanized, stainless steel or plastic coated accessories where concrete surface will be exposed to weather in finished structure and where rust would impair architectural finishes.
   2. Lap welded wire fabric minimum of 12" in structural slabs and minimum of 6" in slabs-on-grade. Support mesh in final position in all slabs. Lifting of mesh into final position is not permitted.
   3. Do not bend bars after embedded in concrete.

B. Cleaning Reinforcement: Remove loose, flaky rust, mill scale, mud, oil, and related coatings that will destroy and reduce bond during concrete placement.

C. Splices: Splice where shown on Drawings or reviewed Shop Drawings.

D. Concrete Reinforcement Protection: If not detailed otherwise, where concrete is deposited against ground, reinforcement shall have minimum of 3" concrete between it and the ground. If concrete surfaces after removal of forms are to be in contact with ground or exposed to weather, protect reinforcing with minimum of 2" of concrete for bars larger than No. 5 and 1-1/2" for No. 5 bars and smaller. Provide minimum 3/4" concrete covering for reinforcing in slabs and 1-1/2" minimum cover in beams at surfaces not exposed directly to ground or weather.

END OF SECTION 03 20 00

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PART 1 - GENERAL

1.01 WORK INCLUDED

A. Cast-in-place concrete, including formwork.

1.02 RELATED WORK

A. Section 03 20 00 - Concrete Reinforcing.

1.03 REFERENCES

A. American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48219 (latest revision).
   1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
   2. ACI 211.2: Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
   3. ACI 211.3: Standard Practice for Selecting Proportions for No-Slump Concrete.
   4. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete.
   5. ACI 304.2R: Placing Concrete by Pumping Method.
   6. ACI 304.3R: High Density Concrete: Measuring, Mixing, Transporting and Placing.
   7. ACI 304.4R: Placing Concrete with Belt Conveyors.
   8. ACI 305R: Hot Weather Concreting.
   9. ACI 306R: Cold Weather Concreting.
   10. ACI 309: Standard Practice for Consolidating of Concrete.
   11. ACI 309.1R: Behavior of Fresh Concrete During Vibration.
   12. ACI 309.2R: Identification and Control of Consolidation-Related Surface Defects in Formed Concrete.
   13. ACI 347: Recommended Practice for Concrete Formwork.

B. American Society of Testing for Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103 (latest revision).
   1. ASTM C33: Specification for Concrete Aggregates.
   2. ASTM C150: Specifications for Portland Cement.
   3. ASTM C260: Specification for Air-Entraining Admixtures for Concrete.
   4. ASTM C309: Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   5. ASTM C494: Specification for Chemical Admixtures for Concrete.
   6. ASTM E329: Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.04 SUBMITTALS

A. Provide the following in accordance with Specifications.
   1. Admixture certification; chloride ion content must be included.
   2. Concrete mix design.
   3. Certification for aggregate quality.
   4. Mill tests for cement.
   5. Method of adding admixtures.
   6. Materials and methods for curing.
   7. Testing agency to perform services required in ACI 301, Section 167.
   8. Laboratory test on concrete.

1.05 QUALITY ASSURANCE

A. Inspection: Engineer shall have access and rights to inspect batch plants, cement mills, and facilities of suppliers, manufacturers, and subcontractors providing products specified.

B. Batch Plant:
   1. Certification: Current certification that weighing scales have been tested and are within tolerances as set forth in National Bureau of Standards Handbook No. 44.
   2. Equipment: Semi-automatic or fully automatic.

C. Obtain materials from same source throughout the Work.

PART 2 - PRODUCTS

2.01 CEMENT

A. Portland cement Type I.

2.02 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

B. Potable.

2.03 CONCRETE AGGREGATES

A. General:
   1. Natural aggregates, well graded, free from deleterious coatings and organic materials conforming to ASTM C33 (latest revision).
   2. Import non-reactive aggregates if local aggregates are reactive. (Appendix XI-ASTM C33).
   3. Wash aggregates uniformly before use.
   4. Other aggregate gradations can be approved by Engineer.

B. Fine Aggregates:
   1. Clean, sharp, natural sand conforming to ASTM C33.
   2. Less than 2 percent passing the No. 200 sieve.

C. Course Aggregates:
1. Natural gravel, crushed gravel, crushed stone, or combination of these materials.
2. Less than 15 percent float or elongated particles (long dimension >5 times short dimension).
3. Less than 0.5 percent passing the No. 200 sieve.

D. Grading Requirements for Course Aggregates:

Sieve Size or Size in in Inches	1-1/2" aggregate	1" aggregate	3/4" aggregate
1-1/2"	95 - 100	---	---
1"	---	90 - 100	---
3/4"	35 - 70	40 - 85	90 - 100
1/2"	---	10 - 40	20 - 55
3/8"	10 - 30	0 - 15	0 - 15
No. 4	0 - 5	0 -5	0 - 5

E. Grading Requirements for Fine Aggregates:

Sieve Size	Minimum	Maximum
3/8”	100	---
No. 4	95	100
No. 8	80	100
No. 16	50	85
No. 30	25	60
No. 50	10	30
No. 100	2	10

2.04 CONCRETE AIR-ENTRAINING ADMIXTURES

A. Manufacturer:
1. Air-Mix or Perma-Air by the Euclid Chemical Co.
2. Sealtight Air Entraining Admixture by W.R. Meadows of Texas.
3. Or approved equal.

B. ASTM C260; nontoxic after 30 days.

C. Use only the specified non-corrosive non-chloride accelerator. Calcium chloride is not permitted.

D. Provide for concrete exposed to freezing and thawing or required to be watertight. Air Content: 5 to 6 percent.

2.05 ADMIXTURES

A. Water-Reducing Admixture: Conforming to ASTM C494, Type A:
   1. Eucom WR-75 by the Euclid Chemical Company.
   2. Pozzolith 200N by Master Builder.
   3. Plastocrete 160 by Sika Chemical Corporation.
   4. Or approved equal.

B. Water-Reducing Retarding Admixture: Conforming to ASTM C494, Type D:
   1. Eucom Retarder-75 by the Euclid Chemical Company.
   2. Pozzolith 100XR by Master Builder.
   3. Plastiment by Sika Chemical Company.
   4. Or approved equal.

C. High-Range Water-Reducing Admixture (Superplasticizer): Conforming to ASTM C494, Type F or G:
   1. Eucom 37 by Euclid Chemical Company.
   2. Rheobuild 1000 by Master Builders.
   3. Sikament by Sika Chemical Company.
   4. Or approved equal.

D. Non-Corrosive Non-Chloride Accelerator Admixture: Conforming to ASTM C494 Type C or E:
   1. Accelguard 80 by Euclid Chemical Company.
   2. Or approved equal.
   3. Manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least 1 year's duration) using an acceptable accelerated corrosion test method using electrical potential measures.

E. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

F. Certification: Submit written conformance to the requirements and chloride ion content of the admixture to Engineer prior to mix design review.

2.06 FORMS

A. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel.

B. Surfaces: New and undamaged condition.

C. Joints: Use tape, gaskets, plugs, or approved calking to keep joints water tight and to allow them to withstand placing pressures without bulging outward or creating surface patterns.

2.07 FORM TIES

A. Factory-made and constructed so that tie remains embedded in wall, except for removable portion at each end.

B. Inserts:
   1. Conical or spherical.
   2. Fixed to remain in contact with forming material.
   3. Constructed so no metal is within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

C. Flat bar ties for panel forms: Plastic or rubber inserts with a minimum depth of 1 inch and sufficient dimensions to permit proper patching of tie hole.

2.08 BONDING AGENT

A. Manufacturer: Sonnebond by Sonneborn; or approved equal.

B. Submit product specifications and manufacturer's specific instructions for application on this Project for Engineer's approval.

C. Product must meet Project requirements with regard to surface, pot life, set time, vertical or horizontal application, forming restrictions, or other stated requirements.

2.09 BOND BREAKER

A. Manufacturers:
   1. Williams Tilt-Up Compound, Williams Distributors Inc., Seattle, Washington.
   2. Silcoseal 77, Superior concrete Accessories, Franklin Park, Illinois.
   3. Or Equal.

B. Nonstaining type.

C. Provide positive bond prevention.

D. Submit for review copies of manufacturer's data, recommendations, and instructions for specific use on this Project.

2.10 CURING COMPOUND

A. Curing and Sealing Compound:
   1. Clear styrene acrylate type, minimum 30 percent solids content.
   2. Test data from an independent testing laboratory indication a maximum moisture loss of 0.030 grams per sq. cm when applied at a coverage rate of 300 sq. ft. per gallon.
   3. Submit manufacturer's certification.
   4. Sodium silicate compounds are not permitted.
   5. Manufacturer:
      a. Super Rez Seal or Super Pliocure by the Euclid Chemical Co.

b. Masterkure 30 by Master Builders.
c. Or approved equal.

B. Exposed Concrete Surfaces:
1. Manufacturer:
a. Kurez DR by Euclid Chemical Company.
b. Or approved equal.
2. Dissipating resin type compound.
3. ASTM C309.
4. Film must chemically break down in 6- to 8-week period.

2.11 BONDING AND REPAIR MATERIALS

A. Rewettable Bonding Compounds:
1. Polyvinyl acetate type.
2. Manufacturer:
a. Euco Weld by the Euclid Chemical Co.
b. Weldcrete by the Larsen Co.
c. Or approved equal.
3. Use only in areas not subject to moisture.

B. Non-Rewettable Bonding Compounds:
1. Polymer modified type.
2. Manufacturer:
a. Euco-Bond by the Euclid Chemical Co.
b. Or approved equal.

C. Bonding Admixture:
1. Latex, non-rewettable type.
2. Manufacturer:
a. SBR Latex or Flex-Con by the Euclid Chemical Co.
b. Daraweld C by W. R. Grace.
c. Or approved equal.

D. Epoxy Adhesives:
1. Two component, 100 percent solids, 100 percent reactive compound.
2. Suitable for use on dry or damp surfaces.
3. Manufacturer:
a. Euco Epoxy No. 452MV or No. 620 by the Euclid Chemical Co.
b. Sikadure Hi-Mod by the Sika Chemical Corp.
c. Or approved equal.

E. Patching Mortar:
1. Free flowing or gel consistency.
2. Polymer modified cementitious mortar.
3. Manufacturer:
a. Euco Thin Coat or Concrete Coat by the Euclid Chemical Co. for horizontal repairs.
b. Verticoat by the Euclid Chemical Co. for vertical or overhead repairs.

c. Sikatop 121 or 122 by the Sika Chemical Co. for horizontal repairs.
d. Sikatop 123 by the Sika Chemical Co. for vertical or overhead repairs.
e. Or approved equal.

F. Underlayment Compound:
1. Free-flowing, self-leveling, pumpable cementitious base compound.
2. Manufacturer:
a. Flo-Top by the Euclid Chemical Co.
b. Or approved equal.

G. Repair Topping:
1. Self-leveling, polymer modified high strength topping.
2. Manufacturer: Thin Top SL by the Euclid Chemical Co.
3. Or approved equal.

PART 3 - EXECUTION

3.01 DESIGN OF CONCRETE MIX

A. Submit mix design on each class of concrete for review; include standard deviation analysis or trial mixture test data.

B. Proportion mix design in accordance with ACI 318, Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures".

C. If trial batches are used:
1. Prepare mix design by independent testing laboratory.
2. Achieve an average compressive strength 1200 psi higher than the specified strength, or 1400 psi for specified concrete strengths over 5000 psi.
3. Certified copies of laboratory trial mix reports and cylinder tests shall be submitted to Engineer by the testing laboratory for approval.

D. Do not place concrete prior to receipt of Engineer's written approval of mixes and cylinder test results.

E. Design mix and perform tests to meet the requirements as specified.

Location	Minimum 28-Day Compressive Strength (psi)	Maximum Water-Cement Ratio	Air Content	Slump Range (in.)
Manholes	3000	.45	5-6 Percent	2-4
Sidewalks	3000	.45	5-6 Percent	2-4
Junction Boxes	4000	.45	5-6 Percent	2-4
Pump Station	4000	.45	5-6 Percent	2-4
Pavements	4000	.45	Optional	2-4

F. Minimum Cement Content (based on aggregate size):

Minimum Cement Content	Maximum Aggregate Size
517 lb/cy	1-1/2-inch
540 lb/cy	1-inch
564 lb/cy	3/4-inch

G. Combined Aggregate Gradings:
1. Aggregates for concrete shall be combined in proportions that will provide a mixture within the grading limits in accordance with this Section, unless otherwise approved in writing by Engineer.
2. Maximum aggregate size depends on rebar clearances.
3. Recommended Admixture Usage:

Location or Condition	Recommended Admixture	Additional Requirements
Air-entrained concrete	Air-entraining admixture	Non-toxic; non-corrosive
Pumped concrete admixture	High-range, water reducing (Superplasticizer)	Initial slump: 2-3 in. Slump with Superplasticizer: 8 inch maximum
Concrete with a water-cement ratio below 0.50	High-range, water-reducing admixture (Superplasticizer).	Initial slump: 2-3 in. slump with Superplasticizer: 8 inch maximum

4. Admixtures:
   a. Concrete shall contain the specified water-reducing admixture or the specified high-range water-reducing admixture (superplasticizer).
   b. Concrete required to be air entrained shall contain an approved air entraining admixture.
   c. Pumped concrete, concrete for industrial slabs, architectural concrete, concrete required to be watertight, or concrete with a water/cement ratio below 0.50 shall contain the specified high-range water-reducing admixture (superplasticizer).

3.02 MEASUREMENT OF MATERIALS AND MIXING

A. Conform to ACI 304 current edition; specified requirements for mix deign, testing, and quality control; and to other requirements of these Specifications.

3.03 RETEMPERING

A. Retempering of concrete or mortar in which the cement has partially hydrated will not be permitted. Redosage with the specified high-range water-reducing admixture (superplasticizer) may be done with the prior approval of the Engineer regarding dosage and time periods.

3.04 FORMS - MAXIMUM SIZE OF CONCRETE PLACEMENTS

A. Coordinate with other trades whose work may be located within or below concrete.

B. Notify Engineer 1 full working day prior to erection of forms for inspection.

C. Thoroughly clean forms and adjacent surfaces to receive concrete; remove chips, wood, sawdust, dirt or other debris before concrete is placed.

D. Design:
   1. Design, erect, support, brace, and maintain formwork in accordance with:
      a. Building Codes Requirements for Reinforced Concrete (ACI 318).
      b. Recommended Practice for Concrete Formwork (ACI 347).
      c. Construction Industry Standards (OSHA 2207).
   2. Design formwork to be readily removable without impact, shock, or damage to concrete surfaces and adjacent materials.

E. Reuse of Forms: Do not reuse forms unless they are in new and undamaged condition.

F. Beveled Edges (Chamfer):
   1. Form 3/4-inch bevels at concrete edges.
   2. Where beveled edges on existing adjacent structures are diverse more than 3/4 inch, obtain Engineer's approval of size prior to placement of bevel form strip.

G. Form Tolerances: Construct forms to sizes, shapes, lines, and dimensions shown, work in finished structures.

H. Removal of Forms:
   1. Do not disturb forms until concrete is sufficiently strong to withstand possible injury.
   2. Do not remove shoring until member has acquired sufficient strength to support its weight and the load upon it.

3.05 FORM TIES

A. Place in uniform patterns on exposed surfaces.

B. Number and placement sufficient to withstand pressures and limit deflection of forms to acceptable limits.

3.06 PLACING CONCRETE - GENERAL

A. Do not place concrete without Engineer being present.

B. Allow other trades reasonable time to complete portions of work which must be completed before concrete is placed.

C. Notify Engineer at least 1 full working day in advance before starting to place concrete to permit inspection of forms, reinforcing, sleeves, conduits, boxes, inserts, or other work required to be installed in concrete.

D. Review curing methods with Engineer and verify curing materials and equipment are at Project site.

E. Placement shall conform to requirements and recommendations of ACI 304 and ACI 318, except as modified in these Specifications.

F. Place concrete as soon as possible after leaving mixer in layers not over 1.5 feet deep:
   1. Without segregation or loss of ingredients.
   2. Without splashing forms or steel above.

G. Vertical Free Fall Drop to Final Placement:
   1. Concrete shall not be dropped freely where reinforcing will cause segregation.
   2. Not to exceed 10 feet for concrete containing high-range water-reducing admixture (superplasticizer).
   3. Not to exceed 5 feet for other concrete.

H. Do not use concrete truck chutes, pipes, finishing tools, etc., constructed of aluminum.

I. Before depositing concrete:
   1. Remove debris from space to be occupied by concrete.
   2. Dampen:
      a. Gravel fill beneath slabs on ground.
      b. Sand where vapor barrier is specified.
      c. Wood forms.
   3. Verify reinforcement is secured in position.

3.07 ADDITION OF WATER AT PROJECT SITE

A. Do not add water to concrete at Project site if slump is within specified range.

B. With the Engineer's approval, add water to concrete arriving at Project site with a slump less than the specified range, provided it can be demonstrated that the specified water-cement ratio will not be exceeded.

C. All concrete shall be 4000 psi at 28 days with a maximum cement water ratio of .45 unless noted otherwise on Drawings.

3.08 CONVEYING

A. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials.

B. Conveying equipment shall be capable of providing a supply of concrete at the site of placement without interruptions sufficient to permit loss of plasticity between successive increments.

3.09 CONSOLIDATION AND VISUAL OBSERVATION

A. Concrete shall be consolidated with internal vibrators having a frequency of at least 800 vpm, with amplitude required to consolidate concrete in the section being placed.

B. At least one standby vibrator in operable condition shall be at the placement site prior to and during placing concrete.

C. Consolidation equipment and methods shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".

D. Vibrator operator is required to see the concrete being consolidated to ensure good quality workmanship; or Contractor shall have a person actually observe the vibration of the concrete and will advise the vibrator operator of changes needed to assure complete consolidation.

E. Do not use vibrators to transport concrete in forms.

3.10 PLACING CONCRETE IN HOT WEATHER

A. Follow the recommendations in Hot Weather Concreting, ACI 305.

B. Do not place concrete at times when temperature is forecast to exceed 100 degrees F. within 12 hours after the concrete is placed.

C. Verify preparations are complete before ordering concrete so that concrete may be placed upon arrival.

D. Fog spray forms, reinforcing steel, and subgrade just before placing concrete.

E. Minimize size of concrete placements and thickness of layers of concrete.

F. Make every effort to maintain concrete temperature:
   1. Below 90 degrees F. at time of placement, cool the ingredients before mixing by use of chilled water.
   2. Uniform:
      a. Minimize the time of placement.
      b. Begin each operation in concrete finishing promptly when the concrete is ready for it.

G. Place concrete promptly upon arrival at Project and vibrate immediately after placement.

H. Do not add water to retemper.

I. Consider placing concrete in late afternoon as opposed to early morning.

J. Provide windbreaks, shading, and fog spraying on days when temperature is forecast to exceed 90 degrees F.

K. Saw-Cut Joints:
1. Maximum Joint Spacing: 36 times slab thickness, unless otherwise noted on Drawings.
2. Soft-Cut Saw: Cut to a depth of 1-1/4-inch immediately after final finishing.
3. Conventional saw shall be used as soon as possible without dislodging aggregate to a depth of 1/4 slab thickness.

L. Protect and cure exposed surfaces by one of the following:
1. Continuous water curing.
2. Moisture-cover curing.

3.11 PLACING CONCRETE IN COLD WEATHER (ACI 306R)

A. Preparation:
1. Follow recommendations in Cold Weather Concreting, ACI 306.
2. Additives for the sole purpose of providing freeze protection shall not be used.
3. Arrangements for covering, insulating, housing, or steam heating newly-placed concrete shall be made in advance of placement and shall be adequate to maintain temperature and moisture conditions recommended.
4. Temperatures of concrete mix shall be as shown as follows for various stages of mixing and placing of concrete mix:

Section Size, Minimum Dimension				
Air Temperature	**12 Inches**	**36 Inches**	**72 Inches**	**72 Inches**
Minimum concrete temperature as mixed for indicated weather:				
Above 30° F	60° F	55° F	50° F	45° F
0° F to 30° F	65° F	60° F	55° F	50° F
Below 0° F	70° F	65° F	60° F	55° F
Maximum allowable gradual temperature drop in first 24 hours after end of protection:				
	50° F	40° F	30° F	20° F

B. Placement:
1. Surfaces to be in contact with concrete shall be free of snow, ice, and frost and shall be above 40 degrees F.
2. Do not place concrete on frozen subgrade.
3. Placement of insulating material, tarpaulins, or other movable coverings shall follow closely the placing of concrete so that only a few feet of concrete are exposed to outside air at anytime.

C. Curing and Protection:
1. Keep concrete continuously moist and maintain concrete temperature at a minimum of 50 degrees F. for 7 days; temperature shall be uniform throughout

concrete. If high early strength concrete is used, this temperature requirement may be reduced to 3 days.

2. It is recommended to leave forms in place for the entire period of protection; use insulated blankets or other approved method on slab surfaces.
3. Limit rapid temperature changes at end of protection period to avoid thermal cracking.

3.12 BONDING TO CONCRETE SURFACES

A. New Concrete Surfaces:
   1. New concrete is defined as less than 60 days old.
   2. Roughen surface to hardened concrete.
   3. Thoroughly clean and saturate with water.
   4. Immediately place concrete.
   5. Horizontal surfaces:
      a. Cover surface with 2-inches of grout.
      b. Limit first lift on top of grout to 12-inches.
      c. Thoroughly vibrate to mix and consolidate grout and concrete.

B. Old Concrete Surfaces:
   1. Use bonding agent.
   2. Prepare surface in strict accordance with manufacturers printed instructions and recommendations for specific and application for this Project.
   3. Follow manufacturers recommendations.

3.13 EVALUATION AND ACCEPTANCE OF CONCRETE

A. Conform to ACI Standard Building Code requirements for reinforced concrete (ACI 318), Section 4.7, "Evaluation and Acceptance of Concrete", and to the following specifications:

B. Testing Responsibilities:
   1. Contractor:
      a. Collect, label, and handle test specimens at Project site.
      b. Provide adequate facilities for safe storage, curing, and protection for first 24 hours and for additional time as may be required before transporting to test lab.
      c. Deliver test specimens to laboratory.
      d. Pay for testing.

C. Number of Test Cylinders:
   1. Set of Cylinders: Three (3).
   2. Sample Frequency:
      a. 1 set/class of concrete/50 cubic yards.
      b. 1 set/class of concrete/3000 square feet of wall or slab surface.
      c. 1 set/class of concrete/day.
      d. Whichever is greater.

D. Laboratory shall test 3 cylinders for the 28-day strength test. The test results should be the average strength of the 3 cylinders, except that if 1 cylinder shows obvious evidence

of improper sampling, molding or testing, it should be discarded and the strengths of the other 2 cylinders averaged. If more than 1 cylinder shows defects, the test should be abandoned.

3.14 PATCHING – GENERAL

A. Prior to starting patching work, except as specified, obtain Engineer's approval of proposed patching techniques and mixes.

3.15 REPAIR OF DEFECTIVE AREAS

A. Definition: Concrete in place that does not conform to specified design strength, shapes, alignments, and elevations as shown on Drawings and contains surface defects.

B. Evaluation and acceptance of concrete shall conform to ACI 318.

C. With prior approval of Engineer, as to method and procedure, repair defective areas in conformance with ACI 301, Chapter 9, except that the specified bonding compound shall be used.

D. The specified patching mortar may be used in lieu of the above-mentioned method when color match of adjacent concrete is not required. Prior approval of Engineer is required.

E. Surface Repairs:
   1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner.
   2. Honey-combed areas and rock pockets:
      a. Repair immediately after removal of forms.
      b. Prepare no-slump concrete mortar and test so that, when dry, patching mortar will match surrounding color and strength.
      c. Cut out to solid concrete or minimum of 1-inch depth.
      d. Make edges for cuts perpendicular to the concrete surface.
      e. Thoroughly clean and dampen with water.
      f. Apply bonding compound.
      g. Compact no-slump concrete into patch, and finish to blend with adjacent finished concrete.
      h. Cure in same manner as adjacent concrete.
   3. High Areas: Grind after concrete has cured at least 14 days.
   4. Low Areas:
      a. Repair during or immediately after completion of surface finishing operations.
      b. Cut out low areas and replace with fresh concrete of same type and class as original concrete.
      c. Finish repaired areas to blend into adjacent concrete.
   5. Defective Areas:
      a. Cut out and replace with fresh concrete of same type and class as original concrete.
      b. Finish repaired areas to blend into adjacent concrete.

6. Make structural repairs with prior approval of Engineer, as to method and procedure, using the specified epoxy adhesive or epoxy mortar. Where epoxy injection procedures must be used, use an approved low viscosity epoxy made by the manufacturers previously specified.
7. Level floors for subsequent finishes by use of specified underlayment material.
8. Where required, level exposed floors by use of the specified self-leveling repair topping.
9. Repair methods not specified above may be used, subject to approval of Engineer.

3.16 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

A. Submit proposed blockouts for review in accordance with Specifications.

3.17 CURING OF CONCRETE

A. Follow recommendations in Standard Practice for Curing Concrete (ACI 308).

B. Begin curing as soon as free water has disappeared from concrete surface after placing and finishing.

C. Continue curing for at least 7 days without interruption.

D. Curing Methods:
1. Water Curing:
   a. Cover surface with burlap or sand (1-inch deep) as soon as possible without marring surface.
   b. Keep continuously wet for 7 days; do not allow surface to become alternately wet and dry.
   c. Use water not more than 2 degrees F. cooler than concrete.
   d. Allow surface to dry slowly before removing burlap or sand.
2. Moisture-Cover Curing:
   a. Cover surface with plastic film (4 mil minimum) as soon as possible without marring the surface. Cover entire surface without wrinkles or holes.
   b. Cover plastic film with 1-inch of sand and weight edges.
   c. Keep covered for a minimum of 7 days.
3. Curing Compounds:
   a. Verify compatibility with required finishes such as hardeners, paint, stain, tile, or other specified work.
   b. Exposed concrete receiving mastic applied adhesive, or metallic or mineral aggregate hardeners shall be cured with the specified curing and sealing compounds.

E. Cold-Weather Curing:
1. Use moisture-cover curing or liquid membrane-forming compound as approved.
2. Protect concrete from temperature changes in accordance with ACI 306.

F. Hot-Weather Curing: Use water curing or moisture-cover curing as approved.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Cast-in-place, reinforced concrete required. Provisions of this Section are applicable to structural concrete at building as well as to site improvement work.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.
   1. Design Mix: Prior to placement of concrete, submit concrete mix designs proposed by the concrete supplier for class of concrete, including recent test results substantiating the quality of concrete produced by each mix.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Qualifications of Workmen:
   1. Provide foreman at all times during execution of this portion of the Work, thoroughly trained and experienced in placing type concrete specified and who shall direct work performed under this Section.
   2. Finishing of Exposed Surfaces of Concrete: Use thoroughly trained and experienced journeyman concrete finishers.

B. Codes and Standards:
   1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations of "Building Code Requirements for Structural Concrete", publication ACI CODE-318 of latest issue of the American Concrete Institute.
   2. American Concrete Institute, ACI PRC-302.1, latest issue, Guide to Concrete Floor and Slab Construction.
   3. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.
   4. ACI SP-66 - ACI Detailing Manual.
   5. ACI 301 - Standard Specifications for Structural Concrete.

6. ACI SPEC-301-20: Specifications for Concrete Construction.

1.05 LABORATORY TESTING

A. All required testing will be performed by testing laboratory selected by Owner. Cost for laboratory services for concrete tests and mix designs paid by Contractor. Material for tests furnished by Contractor.

B. Contractor shall submit three (3) copies of certified laboratory test reports to Architect for review.

C. Testing Procedures:
   1. Material Testing: Laboratory to re-check at plant materials as often as necessary to produce concrete of specified strength and consistency including:
      (a) Fine aggregate.
      (b) Coarse aggregate.
      (c) Cast-in-place concrete.
   2. Concrete Slump: 6" with allowable variation of plus or minus 1 inch.
   3. Quality Control: As work progresses testing laboratory personnel shall conduct tests of concrete in accordance with following procedures:
      (a) Secure composite samples from the same batch complying with ASTM C 172.
      (b) Perform one (1) slump test for each set of strength test cylinders complying with ASTM C 143.
      (c) Make one (1) strength test (4 specimens) for each 40 cubic yards and at least one (1) set for each day's pour.
      (d) Mold four (4) strength test specimens from each sample complying with ASTM C 31 and protect and cure under standard moisture and temperature conditions in accordance with Section 7 of above ASTM method.
      (e) Test two (2) specimens at seven (7) days complying with ASTM C 39. If specimens for a particular batch test at or above required strength for that batch, it is not necessary to test the remaining specimens. Hold the remaining specimens for an additional ninety (90) days in case future testing is required. If the specimens tested at seven (7) days do not meet or exceed the desired strength requirements, the remaining two (2) specimens will be tested at twenty-eight (28) days. Average strength of two (2) specimens from each group tested is basis for acceptance or rejection of concrete. If tested strength falls below strength specified at twenty-eight (28) days, Architect has the right to order the removal and replacement of defective concrete at Contractor's expense. If Contractor wishes to obtain test cores from in-place concrete, cost of coring, testing and patching will be paid by Contractor.
   4. Flatness: Variation in flatness within a 10' area shall not exceed 1/8" +/-.

1.06 REFERENCES

A. Publications listed below form a part of this specification to extent referenced.

1. ACI 117-10: Standard Specifications for Tolerances for Concrete Construction and Materials
2. ACI 211.1-91(R2009): Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
3. ACI 211.2-98(R2004): Standard Practice for Selecting Proportions for Structural Lightweight Concrete
4. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
5. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
6. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
7. ASTM C260 - Standard Specification For Air-Entraining Admixtures For Concrete.
8. ASTM C33/C33M-23 - Standard Specification for Concrete Aggregates

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: Conform to ASTM "Standard Specifications for Portland Cement", C150, Type I. Use one brand of cement. Mix shall contain at least 470 lb. of Portland Cement per cubic yard of concrete. Use 520 lb of cement if freeze thaw deicing chemicals used or required by conditions.

B. Aggregates: Conform to ASTM "Standard Specifications for Concrete Aggregates", C33. Provide aggregate of natural sand and gravel or prepared from stone or gravel, free from adherent coatings. Maximum size of pieces 1", except for footings and foundation walls which may be 1-1/2" maximum size. Use pea gravel aggregate for concrete mix used for filling voids in concrete block walls where required. Aggregate for topping slabs not larger than 3/4" with 30% to 50% passing a 1/2" sieve.

C. Water: ASTM C1602. Clean and free from injurious amounts of oils, acids, alkalis, organic materials, and deleterious substances. **Non-potable water will not be used in concrete mixing.**

D. Fly ash will NOT be allowed except at below grade applications. DO NOT USE in architecturally exposed concrete, particularly at floor conditions, including polished concrete, if applicable.

E. Air Entrainment: ASTM C260 and ASTM C494. Comply with current building code.

2.02 CONCRETE STRENGTHS

A. Cast-in-place Concrete: Designed to develop 3,500 psi minimum compressive strength at 28 days, unless noted otherwise on Structural Drawings. ***Refer to Division 32, EXTERIOR IMPROVEMENTS for strengths required for various concrete site improvements.***

2.03 GROUT

A. Non-Shrink, Non-Metallic, Flowable Grout meeting ASTM C1107/CRD C621 (structural steel grouting, base plates, anchor bolts, tuck pointing):
   1. Con-Spec CS-100
   2. W.R. Meadows Sealtight CG-86™
   3. Master® Builders Solutions MasterFlow 110AN
   4. L&M DURAGROUT™
   5. SikaGrout 212
   6. Kaufman Products SureGrout
   7. Euclid N.S. Grout
   8. Dayton Superior 1107 Advantage Grout
   9. Approved equal.

2.04 CONCRETE FLOOR SEALER

A. Furnish and apply to concrete surfaces shown on finish schedule as "Sealed Concrete", polyurethane concrete sealer:
   1. Spec Cote Urethane by Dayton Superior. Primer to be Spec Cote WB High Performance Water-Based Epoxy Coating.
   2. Approved equal.

B. Surface Preparation: Concrete floor should be sound clean and dry and free of oil, dirt, grease, paint, laitance, and the typical membrane forming curing compounds. The concrete should be at least 28 days old. Floors should be mechanically prepared i.e., shot-blast, sandblast, to result in a International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) of between CSP #1-2, or the texture of medium grit sandpaper to ensure proper adhesion. If oils or grease are present chemical degreasers should be used to thoroughly degrease concrete before shot-blasting.

C. Minimum of two (2) applications are required.

D. Provide clear color for all applications.

2.05 COLOR ADMIXTURE

A. Provide integral color admixture as manufactured by Southern Color Company, Inc. Proportion colored admixture in accordance with manufacturer’s recommendations to achieve specified concrete mix properties. Color(s) to be selected by Architect from manufacturer’s complete line.

2.06 COLOR STAIN

A. Provide "Lithochrome Chemstain" as manufactured by L.M. Scofield Co., 1-800-800-9900, or approved equal. Apply "Chemstain" in addition to "Cementone" clear sealer or "Colorcure" concrete sealer in accordance with manufacturer's recommendations over "Lithochrome Color Hardener" to achieve desired color. Color(s) to be selected by Architect from manufacturer's standard line.

2.07 CONCRETE PIGMENTS

A. Solomon Colors, Inc., PO Box 8288, Springfield, Illinois 62791. Phone (800) 624-0261 / (217) 522-3112. Web Site: www.solomoncolors.com

B. Integral Colors for Ready Mix Concrete: Available in dry, ColorFlo liquid (recommended) and ColorFlo granular pigments. Meet ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete.

C. Dry Shake Colored Hardeners: SGS Dry Shake Colored Hardener.

2.08 UNDERSLAB DRAINAGE FILL

A. Crushed stone or washed gravel, uniformly graded from 1 inch minimum to 3/4 inch maximum size.

2.09 CONCRETE JOINT FILL AND SEALANT SYSTEM

A. Provide VersaFlex SL/Series self-leveling, 100% solids, flexible, two component, modified polyurea based elastomeric joint sealant material for both interior and exterior use in a color as selected by the design professional. Designed for 25% movement of an installed joint width. Install per manufacturer's published recommendations.
   1. Fill exterior random cracks, contraction or control joints, or new construction and expansion joints on new or old horizontal concrete surfaces.
   2. Compressible backer rod is prohibited in saw-cut joints unless 2" depth is exceeded. Interior saw cut joints should be filled full depth with a polyurea joint filler. Exterior saw cut joints should be filled with a joint sealant such as SL/60 or SL/45.

2.14 OTHER MATERIALS

A. Provide materials, not specifically described but required for complete and proper installation of cast-in-place concrete, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 MIXING AND PLACING CONCRETE

A. Preparation: Clean equipment for transporting concrete. Remove debris, water, and ice from places to be occupied by concrete. Remove laitance and unsound material from hardened concrete before additional concrete is added.

B. Mixing: Ready-mixed concrete, mixed and delivered in accordance with following requirements only of ASTM C 94.
   1. Tolerances in Slump,
   2. Measuring Materials,
   3. Batching Plant,
   4. Mixers and Agitators,
   5. Mixing and Delivery,
   6. Use of Non-Agitating Equipment
   7. Inspection.

C. Conveying: Convey concrete from mixer to place of deposit by methods that prevent separation and loss of materials.

D. Placing:
   1. Deposit as nearly as practicable in final position to avoid segregation due to re-handling and flowing. Place at rate to assure concrete is plastic and flows readily into spaces between bars. Do not use concrete contaminated by foreign material or re-tempered concrete.
   2. When placing is started, carry a continuous operation until placement of panel or section is completed.

E. Hot Weather Concreting: Place, handle, and cure concrete complying with ACI SPEC-305.1.

F. Cold Weather Concreting: Provide adequate equipment for handling concrete materials and protecting concrete during freezing and near freezing weather. Concrete materials, reinforcements, forms, and ground in contact with concrete to be free of frost, snow, and ice. Details of approved procedures are available in ACI SPEC-306.1. Contractor to keep accurate thermometer on job where the work is proceeding.

G. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).

3.02 PROTECTION OF ADJACENT SURFACES

A. Contractor responsible for any work soiled and stained by dripping cement, water, or concrete. Protect same with tarpaulin or similar devices while pouring concrete.

3.03 CONSOLIDATION

A. Consolidate concrete by vibration, spading, rodding, or forking. Work around reinforcement, embedded items and into corner of forms. Over-vibrating and use of vibrators to transport concrete within forms not allowed. When consolidating by vibration, keep spare vibrator on job site during concrete placing. Use vibrators of length to extend within 6 inches of bottom of freshly poured concrete, vibrator being raised with each succeeding pour.

3.04 CONCRETE CURING AND FINISHING

A. **Curing Period:** Cure concrete for minimum period of 7 days at a temperature above 50° F. by one of approved methods listed below. Protect fresh concrete from heavy rain, flowing water, mechanical injury and from injurious action of sun. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

B. **Potable Water Curing:** If cured with water, keep concrete wet by mechanical sprinklers or by any approved method which will keep surface continuously wet.

C. **Evaporation Retarder:** Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions prevail. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. **Curing Compounds: NO CHEMICAL CURING COMPOUNDS ALLOWED.**

E. **Waterproofing Paper or Opaque Polyethylene Film:** Conform to ASTM C 171. Cover concrete immediately following final finishing operation. Anchor securely, seal edges or apply in manner to prevent moisture escaping from concrete.

F. **Curing Blanket:** AASHTO M-182, Class II, ASTM C-171 burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

G. **Concrete Patching:** Immediately after stripping forms, examine surfaces. Patch honeycombing, defective joints, voids, tie holes, and defects before concrete is thoroughly dry. However, make no attempt to correct or fill any honeycomb spots, or any other defects until they have been examined by Architect and approval obtained as to correction to be employed. Finish of patch to match adjoining surface.

H. **Concrete Finishes (ACI 301, latest edition):**

1. Interior General: Floor slabs, including topping slabs, to be smooth and steel troweled to hard dense surface (non-burnished), except where required to be depressed. Rough float finish depressed surface. Protect concrete floors during construction period.

2. Exterior: Pads, Steps, Stairs, Slabs and other surfaces to receive light-medium broomed finish for non-slip surface.

3.05 FLOOR SLOPE TO DRAINS

A. Slope floors to drain outlets. Low spots where pools of water can stand on finished floors are not acceptable. Slope to drains 1/8" per lineal foot unless otherwise marked.

B. Slope floors uniformly from perimeter walls and partitions to drain outlets (unless otherwise indicated).

C. When multiple drains are shown in a room, space equally. Create dedicated area per drain outlet and slope floor uniformly from area perimeter to drain outlet (unless otherwise indicated).

3.06 SLIP-RESISTANT ADDITIVE

A. Provide GRIP IT™ non-slip finish with abrasive aggregate emery grits or No. 12 carborundum grains by L & M Construction Specialties, or approved equal, where shown on drawings. Apply during finishing at uniform rate of 35 pounds per 100 square feet, after screeding and floating, just prior to troweling. Steel trowel aggregate into surface during finishing. Apply DRESS & SEAL WB 30™ or equal curing compound after finishing.

B. H&C™ SharkGrip® as provided by Sherwin-Williams, where noted on the drawings.

END OF SECTION 03 30 10

This Section equally applies to the artificial themework materials and installation process, and shall be reviewed and followed along with Specification Section 03 37 20 "Artificial Themework." This Section shall be followed by the Artificial Themework Contractor. If there are any discrepancies found between this Section and the "Artificial Themework" Section, the Artificial Themework Contractor shall notify the Architect.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Dry-mix shotcrete.
   2. Wet-mix shotcrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each shotcrete mixture.

C. Shop Drawings: For shotcrete installation.
   1. Detail fabrication, bending, and placing of reinforcement; number and location of splices.
   2. Indicate locations of proposed construction joints.

D. Samples: For each exposed product and for each color and finish specified.

E. Provide mock-ups, in coordination with Section 03 37 20 "Artificial Themework."

1.5 INFORMATIONAL SUBMITTALS

A. Material certificates.

1.6 QUALITY ASSURANCE

A. Standard: Comply with ACI 506.2, "Specification for Shotcrete," unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials indicated within this Section are minimum requirements. Contractor shall verify requirements with Structural Documents, and if deviations, shall notify the Architect.

2.2 REINFORCING MATERIALS

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Plain-Steel Wire: ASTM A1064/A1064M, as drawn and as indicated on shop drawings.

D. Welded Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire, furnished in flat sheet.

2.3 SHOTCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I. Use only 1 brand and type of cement for Project.
   1. Fly Ash: ASTM C618, Class C or Class F.
   2. Slag Cement: ASTM C989/C989M, Grade 100 or Grade 120.

B. Normal-Weight Aggregates: ASTM C33/C33M, from a single source, and as follows:
   1. Combined Aggregate Size: ACI 506R or ASTM C1436, Grading No. 2 sieve analysis.

C. Admixtures: ASTM C1141/C1141M, Class A (liquid) or Class B (nonliquid), but limited to the following admixture materials. Provide admixtures for shotcrete that contain no more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.
   1. Accelerating Admixture, Conventional: ASTM C494/C494M, Type C or Type E.
   2. Pozzolanic Admixture: Fly ash and slag cement as limited in "Portland Cement" Paragraph in this article.
   3. Coloring Admixture: ASTM C979/C979M, synthetic mineral-oxide pigment or colored, water-reducing admixture, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.
   4. Air-Entraining Admixture: As limited in "Shotcrete Mixtures" Article.
   5. Waterproofing Admixture (for Interior and Exterior Pool Installations): Aquafin-IC, per manufacturer’s installation instructions.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry, or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Curing Compound: ASTM C309, Type 1, Class B; clear, waterborne, membrane-forming curing compound.

2.5 WATERPROOFING MEMBRANE

A. Waterproofing Membrane (for Interior and Exterior Pool Installations): Aquafin-2K/M, per manufacturer’s installation instructions.

2.6 SHOTCRETE MIXTURES

A. Design Mixtures: Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.

B. Cementitious Materials Replacing Portland Cement: Use fly ash, pozzolan, and slag cement as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.

D. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

E. Shotcrete Mixture: Proportion mixture to provide shotcrete with the following properties:
   1. Compressive Strength (28 Days): 4,000 psi.
   2. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight wet-mix shotcrete having an air content before pumping of 7 percent with a tolerance of plus or minus 1-1/2 percent.
   3. Color: As selected by Architect from manufacturer's full range of industry colors, implemented into mock-ups, and as required to create the artificial, but natural-appearing, environment indicated on the Drawings and Specifications.

PART 3 - EXECUTION

3.1 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

3.2 APPLICATION

A. Apply shotcrete applied by dry-mix or wet-mix process and according to ACI 506.2.

B. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.

C. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.

D. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.
   1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
   2. Remove and dispose of cuttings during the trimming or rodding process to prevent unconsolidated material from falling onto lower reinforcement.

E. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray, and prevent buildup against front face during shotcreting.

F. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.

G. Do not permit shotcrete to sag, slough, or dislodge.

H. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.

I. Do not disturb shotcrete surfaces before beginning finishing operations.

J. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117, increased by a factor of 2.

K. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

L. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 305.1 when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete.

3.3 SURFACE FINISHES

A. Finish shotcrete according to descriptions in ACI 506R.

B. Natural Finishes:
   1. Gun Finish: Natural undisturbed finish as sprayed.
   2. Rod Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set. Do not push or float with flat part of trowel.
   3. Broom Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set; followed by uniform brooming.
   4. Artificial Themework Finish: As indicated on the Drawings and as required by Specification Section 03 37 20 “Artificial Themework.”

3.4 CURING

A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.

B. Begin curing immediately after placing and finishing but not before free water, if any, has disappeared from shotcrete surface.

C. Curing Exposed Surfaces: Cure shotcrete by 1 of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with water, continuous water-fog spray, water-saturated absorptive covers, or moisture-retaining covers. Lap and seal sides and ends of covers.
   2. Curing Compound: Apply uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Apply curing compound to natural gun and flash-coat finishes at rate of 1 gal./100 sq. ft.

3.5 REPAIRS

A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets.

3.6 CLEANING

A. Immediately remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

3.7 PHOTO REFERENCE

A. Photographs of representative natural features are included at the end of this Section, for artistic guidelines to the types of features, details, colors, etc., to be used in the creation of the Artificial Rockwork.

B. Shotcrete Contractor shall coordinate with Artificial Themework Contractor for the creation of the artificial environments required in this facility, and for each of the represented animal species. Mock-ups of the Shotcrete and Artificial Themework of the represented environments shall be approved by the Owner and the Architect prior to further related activities and completion of the required Work.

END OF SECTION 03 37 13

Capybaras and Squirrel Monkeys are native to Central and South America, and are typically found in dense tropical rainforests and other wooded areas near bodies of water such as river, lakes, ponds, marshes, or swamps.

Themed rock shall create the look of the natural rock formation in their natural habitat. All colors, surface textures, and general rock shapes shall be similar to the reference photos provided on this page for Capybara Dayroom (Room 115) and Squirrel Monkey Dayroom (Room 109) in Building 1. Themed rock shall also complement live rock color and texture. Reference "AH-series" and "SH-series" Drawings for design intent (size, location, and design intent) of rockwork.

The Giant Anteater primarily inhabits the Grasslands (Savannas) of Central and South America, often in open areas where they can easily spot ant and termite mounds. Giant Anteaters are adaptable and can live in areas ranging from lowland forests to highland savannas, as long as there is a sufficient supply of ants and termites.

Themed rock shall create the look of the natural rock formation in their natural habitat. All colors, surface textures, and general rock shapes shall be similar to the reference photos provided on this page for Anteater/Flex Dayroom (Room 106) in Building 1. Themed rock shall also complement live rock color and texture. Reference "AH-series" and "SH-series" Drawings for design intent (size, location, and design intent) of rockwork.

Giant Anteater feed almost exclusively on ants and termites, whose nests they rip open with their powerful forelimbs and claws, and then ingest with their sticky tongues. Thematic rockwork where the PVC enrichment feeding tubes are located shall create the look of a natural anteater mound in color, texture, and shape.

Ring-tailed lemurs are native to the spiny forests in the south/southwestern regions of the Island of Madagascar. Their natural habitat includes dry deciduous forests and arid/open scrub lands. Geological variation ranges from limestone plateaus, sandy coastal plains and mountains to volcanic formations.

Themed rock shall create the look of the natural rock formation in their natural habitat. All colors, surface textures, and general rock shapes shall be similar to the reference photos provided on this page for Lemur spaces in Building 2. Themed rock shall also complement live rock color and texture. Reference "AH-series" and "SH-series" sheets for design intent (size and location) of rockwork.

In their native habitat, the Aldabra Giant Tortoise are found on Aldabra Island, one of the Seychelles Islands off Africa northeast of Madagascar in the Indian Ocean. Aldabra Island is a coral atoll boardered by jagged limestone rock formations and small beaches, and encloses a large mangrove bordered lagoon. These Aldabra Tortoises are terrestrial and inhabit a wide range of habitats on the island, including scrub forests, mangrove swamp, and coastal beaches and dunes.

The atoll reflects both fossil and geomorphological features, consisting of reef limestone of Pleistocene age with irregular coral formations. Geologically, the limestone beds have been subjected to striation, sink holes and pits.

Themed rock shall create the look of the natural rock formation in their natural habitat. All colors, surface textures, and general rock shapes shall be similar to the reference photos provided on this page for Aldabra Tortoise spaces in Building 4. Themed rock shall also complement live rock color and texture. Reference "AH-series" and "SH-series" sheets for design intent (size and location) of rockwork.

PART 1 - GENERAL

The Project consists of artificial themework of rock formations, water features, pools, trees (deadfall trunk climbing features), and artificial vines and vegetation, for the creation of artificial but natural-looking environments in 3 buildings housing various animals, such as capybara, squirrel monkeys, anteaters, lemurs, and tortoises, as well as outdoor exhibit areas, as shown on the Drawings.

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Furnish all materials, equipment, supplies, and manpower incidental to conduct all forming, fabrication of reinforcing material, shooting of concrete, sculpturing, staining, and other incidental work.

B. Water features, pools, rocks, trees, etc.

C. Staining and painting of artificial themework.

D. Retaining walls or structures encased in “themework” as shown on Drawings are by the General Contractor.

E. All Work required to fully construct and finish completely the required shotcrete simulated structures shall be a part of this Contract, including related foundations and support structures, excepting only items of this nature which may be specifically noted as furnished by the General Contractor.

F. Coordinate excavation, subgrade preparation, and backfill with General Contractor.

1.3 DESCRIPTION

A. Artificial rockwork, pool and trees shall be constructed in the location and of types as shown on the Drawings and as specified herein. The Work shall be constructed by a firm qualified according to criteria in Article 1.5 below. Firm shall be contracted with by the General Contractor according to the criteria established in this Section. All other conditions of the Contract regarding subcontracting awards are applicable.

1.4 DEFINITIONS

A. Contractor: A company who specializes in a certain aspect of construction. For the purposes of this Section, a company whose primary business is the construction of naturalistic simulated rocks, and trees (Themework Contractor [TC]).

B. General Contractor: The company contracted for the general construction of buildings, sitework, and utilities.

1.5 GENERAL REQUIREMENTS

A. The Themework Contractor shall provide a 1-year warranty on trees, pool and simulated rock formations. All pools, interior and exterior, shall be designed to provide a lifespan of 20 years, under normal wear conditions, in which the product remains free of visual change and does not require structural repair or extensive maintenance.

B. The artificial trees and rock formations shall be an imitation of naturally occurring rock structures and trees in color ranges and texture as approved by the Owner and Architect. In general, the artificial trees and rockwork shall consist of a steel skeleton supporting structure covered with metal wire fabric and pneumatically applied colored concrete that has been sculpted, carved, textured, stained, and/or painted.

C. The Themework Contractor shall coordinate with the General Contractor to allow for installation of plumbing for waterfall, pool and drains as shown on the Drawings.

D. The material and method of application used for themework must be able to simulate the appearance of natural rock, and trees, which may require shading of cracks and highlighting of some areas.

E. The Themework Contractor shall be responsible for the detailed design and appearance of the rock formations and trees, which shall be of the general style and geological character approved by the Owner and Architect and as indicated in the Drawings and Specifications.

F. The Themework Contractor shall be responsible for the structural design of the system, including attachment methods. If the weight of the system dictates special foundation or support structures, it shall be engineered and constructed by the Themework Contractor as part of his original Contract. The supporting structure shall be designed to support superimposed dead and live loads as indicated, or required. The design shall be approved and certified by a qualified Professional Engineer who is legally qualified to practice in the State of Arkansas and experienced in providing engineering services of this type. Structural designs should take into consideration the need for animal and maintenance staff to access all areas of the habitat. It should be assumed the full weight of a grown human will be imposed on said structures unless otherwise directly implied in writing by the Owner.

G. If the artificial trees and rock formations are produced in panels or increments, the jointing system shall be such that after installation, all joints will be invisible.

H. The design and construction of the trees and rock forms shall be such that thermal expansion and contraction and any shrinkage of materials can be accommodated with concealed expansion or control joints to prevent uncontrolled cracking.

I. The end product in each case shall, in the opinion of the Architect and Owner, be realistic in form, texture, color variations and sheen, and in general must have the appearance and character of natural environment.

J. The trees and rock formations shall be so designed and constructed to withstand the structural loadings specified in this Section.

K. Provide in the design the methods of inconspicuous venting of voids behind rockwork as applicable and as required.

1.6 GENERAL DATA

A. The Work under this Contract shall be carefully coordinated with the work of other Contractors so that the installation of these elements does not impede progress or delay the completion of the facility. The General Contractor will provide the construction schedule and the Themework Contractor will perform his/her work to maintain the established pace and progress of the Project.

B. All excavation, grading or earthwork, and the compaction and preparation of subgrade, as required to complete the Work of this Contract, shall be done by the General Contractor. The Themework Contractor shall coordinate with the General Contractor to ensure elevations are met and subgrade preparation is consistent with structural requirements. Demolition work as required for this Contract Work will be done by the General Contractor.

C. This Work must be fitted to the profiles of structures and site conditions and be securely anchored. All anchorage devices shall be concealed from public view.

D. The Themework Contractor shall provide all required anchors and methods of attachment. If anchors must be built into the building construction, coordinate such work with the General Contractor for the building construction.

E. Protect adjacent work of other contracts from damage or discoloration due to operations under this Contract.

F. If, during the installation of the artificial work formations, it is established that functional defects or problem conditions exist, the Owner reserves the right to require modifications to the rock forms in order to eliminate such unfavorable conditions.

G. At the completion of the Work, all waste and excess themework materials shall be removed from the premises and disposed of by the Themework Contractor.

1.7 QUALITY ASSURANCE

A. Qualified Contractor: All firms must submit qualification requirements as specified and requested by the Owner. The following Shotcrete (Artificial Rock/Themework) Contractors have been provided for the convenience of the General Contractor. It is not the intent of this list to be an all-inclusive list of all firms in the field, nor are the firms on the list automatically qualified. All firms will be considered equally on their ability to comply with qualification requirements and prior experience. In alphabetical order, they are:
   1. Cemrock Naturalistic Landscapes, Inc., 4790 S. Julian Avenue, Tucson, AZ 85714; (520) 571-1999, https://cemrock/com/#ourwork.
   2. COST of Wisconsin, 4201 County Road D, Jackson, WI 53037; (262) 677-6060, https://www/costofwisconsin.com/project/zoo-habitat-fabrication/.
   3. Dixon Studios, Inc., 912 S. Park Avenue, Tucson, AZ 85719; (520) 628-3699.

4. Edge Concrete, 10930 116th Avenue NE, Kirkland, WA 98033; (425) 482-3343.
5. Outside The Lines, Inc., 333 N. Wilmont Road, Suite 340, Tucson, AZ 85711; (520) 329-6464.
6. Rock and Waterscape Systems, Inc., 3275 Lapeer Road W., Auburn Hills, MI 48326; (248) 318-3855.
7. Total Habitat: https://totalhabitat.com/custom-habitats.html. (785) 856-5546, extension 700.

B. Work Force: The Themework Contractor shall employ skilled or professional help, 1 or more as may be required, with the ability to sculpt the fresh shotcrete to simulate natural rock, plaster, trees, and other formations.

C. Codes and References: American Concrete Institute Standard 506R-90, "Guides for Shotcrete," shall be made a part of these Specifications.

1.8 SUBMITTALS

A. The successful Themework Contractor shall provide, as part of this Contract, the following work:
1. Consult with the General Contractor to establish the relationship to, or effect upon, other branches of the Work as these support, or relate to, the successful execution of the simulated rockwork.
2. Furnish Drawings, Specifications, or other descriptive material or information as may be required to accomplish the Work, including but not limited to shop drawings sealed by a Structural Engineer.
3. Mock-Ups: After preliminary approval of the designs based on the above, this Contractor shall construct for approval mock-ups of the following, at full scale, having an area of approximately 100 square feet. The mock-up shall demonstrate profiles, styles, textures, colors, and variations to be expected in the final work. If directed, provide additional mock-ups with changes necessary to meet the approval of the Owner and Architect at no cost to Owner. The mock-up may be constructed as part of the permanent installation provided it is acceptable to the Owner and Architect, but no other work shall proceed until final approval of the mock-up is obtained.
   a. Waterfall section.
   b. Pool section.
   c. Artificial rock formations, per Section 03 37 13 "Shotcrete," and this Specification Section.
   d. Trees, per Section 06 13 00 "Heavy Timber Construction," and this Specification Section.
   e. Vines, per Section 32 95 10 "Artificial Vines," and this Specification Section.
4. Material Descriptions: At the completion of the work, submit a written specification of the basic materials used, plus a final adjusted list of mixes showing the proportions of pigment, aggregate, etc., for the Owner's use in future repair work.

1.9 PRODUCT HANDLING

A. Storage of material, parking of vehicles, and the location of the equipment shall be only in designated areas. Coordinate locations with General Contractor and the Owner.

1.10 JOB CONDITIONS

A. No cold weather work (outside air temperature 35 degrees F and falling) will be permitted for artificial rockwork construction unless written permission from Architect has been obtained. Indoor exhibit work shall be accomplished with the HVAC system running and maintaining normal operating temperatures within the facility.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In areas where artificial rockwork is necessary for animal containment, the rockwork method proposed by the Themework Contractor shall equal or exceed the following live loads in addition to all dead loads:
   1. Wind Load: 20 to 25 psf or 90 mph, 3-second gust.
   2. Impact load of 15 kips at 7'-6" height or 500 psf, whichever creates the greater load effect.

B. In areas where artificial rockwork is necessary for animal containment, all connections and anchoring devices shall meet above loads with a safety factor of 2.5.

2.2 CONCRETE

A. Concrete for the construction of additional footings, slabs-on-grade and walls not shown on the Drawings, but required for the Work, shall comply with the requirements of Section 03 30 00 “Cast-In-Place Concrete,” 4,000-psi compressive strength at 28 days.

B. Shotcrete for artificial rockwork shall be wet-mix or dry-mix, in compliance with Section 03 37 13 “Shotcrete.”

2.3 WATER

A. Potable.

2.4 REINFORCING

A. Bars: Deformed reinforcing bars shall be of intermediate grade and conform to ASTM Designation A615 or A616, Grade 60 as to quality and ASTM A305 as to deformations.

B. Mesh: Steel mesh shall conform to ASTM Designation A82 or ASTM A185 and must be galvanized. The size shall be 14-gage and spaced 2 inches on center both ways.

C. Lath and Supports:
   1. Steel Lath: Painted or unpainted expanded metal lath, maximum 1/2-inch clear apertures, or equal.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing supporting, and fastening reinforcing bars.

2.5 COLORING AGENTS

A. All coloring materials are to be high quality, non-toxic, colorfast, and resistant to fading and peeling under normal conditions.

B. Colored Cement Mortar: Where specified, by Medusa "Stoneset," Louisville Masonry Mortar, or approved equal.

C. Chemical Stains: Shall be "LITHOCHROME," "Chemstain" Classic, as manufactured by the L. M. Scofield Company, Los Angeles, California, or approved equal.

D. Acrylic Paints: Shall be Benjamin Moore, or approved equal.

E. It is the intention to imitate natural trees and rock appearance and to provide textures and shading cracks and highlighting of rock formations. This shading and highlighting shall be accomplished by using mineral oxide colors to be selected by the Contractor and approved by the Architect. The material shall be applied with airless type spray equipment.

2.6 WATERPROOF MEMBRANE

A. Provide waterproof membrane at pond areas to above static water level by 1 of the following methods:
   1. Aquafin-2K/M flexible cementitious protective coating and waterproofing as manufactured by Aquafin, Inc., Triumph Industrial Park, 505 Blue Ball Road, Suite 160, Elkton, MD 21921; 1-866-AQUAFIN, www.aquafin.net, or approved equal.
   2. EPDM or PVC liner on all pond subgrades prior to shotcrete work.
      a. Artificial Themework Contractor shall be responsible to provide and install materials needed to seal penetrations from piping, etc., through EPDM/PVC liner per liner manufacturer's recommendations.
   3. Spray-on EPDM liner on base shotcrete slab covered by final shotcrete slab.

2.7 INTEGRAL WATERPROOFING

A. Provide integral waterproofing at all pond areas to 6 inches above static water level.
   1. Aquafin-IC Admix cementitious capillary/crystalline admixture as manufactured by Aquafin, Inc., Triumph Industrial Park, 505 Blue Ball Road, Suite 160, Elkton, MD 21921; 1-866-AQUAFIN, www.aquafin.net, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Inspection:

1. Prior to any Work of this Section, carefully inspect the installed Work of all other trades and verify that such Work is complete to the point where this installation may properly commence.
2. The plumbing and electrical Work will be conducted concurrently, and the Themework Contractor shall cooperate fully with the other Contractors to coordinate the Work involved in this Section with the Work provided by others.

B. Incidental Work: Incidental work shall include all work not specifically indicated or that which may not be specified and not provided for in a basis for payment that is of any incidental or temporary nature and required in order to safely and satisfactorily carry out the intent of the Work as indicated on the Drawings and in the Specifications. The cost of such Work shall be merged with and included in the prices bid.

C. Conduct of the Work:
1. Themework Contractor must be prepared to commence his work promptly and shall lay out and conduct his Work at all times so as not to interfere unnecessarily with operations of the Owner or of other Contractors, and shall work in harmony with such other Contractors to the best interest of the Work as a whole.
2. Every assistance shall be given by the Themework Contractor to the Architect on the job, in checking elevations, grades and determining locations.
3. Themework Contractor shall establish the actual alignment of shotcrete rock formations. Although the final layout shall be subject to approval of the Owner, the Themework Contractor will be held responsible for any misalignment due to faulty measurement or incorrect interpretation of the Drawings.

3.2 EXCAVATION, BACKFILLING, GRADING AND SURFACE PREPARATION

A. Excavation: General Contractor shall make all of the excavations required to complete the construction of foundations for artificial rock formations as shown on the Drawings.

B. Filling and Backfilling: General Contractor shall do all the backfilling required to complete the construction as shown on the Drawings and as specified herein.

C. Grading:
1. General Contractor shall bring the existing grade to the proper subgrade. The subgrade shall be established below bottom of shotcrete foundations unless otherwise shown on the Drawings. Gravel shall be used as backfill or fill material in all excavations and low areas which are below the shotcrete formations or concrete footings.
2. All gravel or base material below shotcrete surfaces and concrete supporting structures shall be compacted in 8-inch layers to a degree which is satisfactory.
3. All excess site materials shall be removed from the site by the General Contractor at his or her expense.

D. Preparation of Subgrade: The surfaces against which shotcrete is to be applied shall be presented in a thoroughly compacted condition and shall be accurately trimmed to line and grade as shown on Drawings. All dry surfaces shall be wetted before application of shotcrete, but shotcrete shall not be placed on any surface which is saturated, spongy or where free water exists.

E. Preparation of the Surface: All concrete or masonry surfaces to receive shotcrete shall be thoroughly cleaned by sandblasting. Sandblasting shall be done by experienced workmen using approved equipment and suitable sandblasting materials. Prior to receiving shotcrete, all surfaces shall be cleaned of dust and debris, using compressed air and water. Concrete and masonry shall be thoroughly wetted before application of shotcrete, but shall not be so wet as to overcome suction. Free water shall not remain on the surface to be shotcreted, nor shall surface be so dry that there is excessive absorption of moisture from the shotcrete.

3.3 SHOTCRETE APPLICATIONS EQUIPMENT

A. Dry-mix shotcrete shall be applied by equipment whereby the dry cement aggregate mixture is delivered by air pressure to the nozzle where water is then introduced.

B. The cement gun shall be equipped with a loader having the following minimum mechanical features:
   1. Accurate proportioning devices by volume or weight.
   2. Tumbling or screw-type mixing to ensure thorough blending.
   3. Variable speed controls.
   4. Clutch control for its mix and elevating mechanism.
   5. A loading hopper above the cement gun.
   6. Mixing range shall be from a minimum of 1:3 to 1:7.
   7. All material must be screened before entering hopper.
   8. Measurement of material by the shovelful shall not be permitted.

3.4 ARTIFICIAL ROCKWORK CONSTRUCTION

A. All indicated materials, product sizes, and methods of installation are minimum requirements. It is the responsibility of the Themework Contractor and its independent Engineer to design and coordinate the required work.

B. Concrete Pads, Columns and Walls:
   1. Methods and procedures used for the construction of additional pads, columns and walls shall conform to Section 03 30 00.
   2. The location, size, shape and structural design of these additional supporting structures shall be determined by the Themework Contractor.
   3. The reinforcing for these supporting concrete structures for artificial rockwork shall be submitted by Drawings and calculations to the Architect/Engineer for approval. Design of the supporting structures is the responsibility of the Themework Contractor and its independent Engineer.
   4. Wherever shotcrete rests on, or is attached to, concrete structures it shall be tied to, but not supported on, said structures by welding to extended reinforcing steel or to steel bar ties. If no reinforcing steel or tie bars are present, the shotcrete steel shall be welded to 1/2-inch-diameter bolts anchored to structure with expansion shields. Bolts shall be placed as directed by the Themework Contractor's Engineer.

C. Steel Reinforcement:

1. No. 3 reinforcing bars shall be placed on 8-inch 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 Architect, it is deemed necessary. A No. 4 bar acting as a key rod shall be placed at intersections of all plane surfaces.
2. All bars are to be welded or tied where they contact or cross each other.
3. All bars are to lap 30 diameters at splices. However, a lap of 4 inches will be allowed if 1 continuous fillet weld of 3 inches in length is used to tie or weld the bars together at the splice.
4. Reinforcing bars shall be placed and bent around circles, corners and angles. 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 shotcrete outcroppings.
5. The tie bars and tie anchors which do NOT come in contact with any backfill material shall be given a protective covering of asphalt coating or at least 1 heavy coat of rust-inhibitive paint.
6. Tie bars and tie anchors which come in contact with backfill material shall be encased with a coating of shotcrete. Steel shall be covered with a minimum of 1 inch of shotcrete.
7. Additional No. 4 bars shall be used diagonally across corners of all openings, and wherever shotcrete formations act as beams, additional No. 5 bars shall be placed at maximum points of maximum stress, i.e., 1 in top and 1 in bottom extending 12 inches into supports. Additional No. 4 bars shall be integrated into steel framework if such steel is necessary to provide a stable structure.
8. The mesh shall be placed on steel reinforcing on the side opposite the backup material and shall be securely wired to the reinforcing bars at no less than 20-inch intervals in both directions. Mesh shall lap at least 2 inches at adjacent ends.
9. Reinforcing bars placed over “Steeltex” or approved equal shall be supported by slab bar bolsters, high chairs, etc. Spacing shall be No. 3 bars as 8 inches on center. Pieces of Truss Loop shall be placed on bar supports.

D. Back-up Construction:
1. All shotcrete formations shall be backed with plastic lath.
2. 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 1 inch. Lath shall be fastened to the reinforcing bars by means of tie wires or steel hog rings. Ties or spacers shall be spaced not more than 10 inches on center in all directions.
3. Plastic lath is not required where horizontal surfaces or walls provide a suitable backup and/or bonding surface and the shotcrete is applied in a solid layer. Reinforcement, however, shall be continuous in these areas and be properly anchored.
4. Plastic lath shall be lapped on all adjacent ends and sides a sufficient amount to stop shotcrete material.

E. Shotcrete (Wet- or Dry-Mix):
1. Shotcrete simulated rock shall consist of the following types of construction:
   a. Base coat with either a colored finish coat or masonry sand finish coat.
   b. Colored flash coat on block walls.

2. The finish coat mix by volume measurement shall consist of 4 parts fine aggregate to 1 part cement mortar Medusa Stoneset or Louisville masonry mortar, or approved equal.
3. The minimum thickness of earth-supported dry-mix shotcrete shall be 4 inches or as shown on the Drawings. The minimum depth or thickness for all other dry-mix shotcrete simulated rock formations shall be 4 inches. Flash coat shall have a thickness of 3/8-inch to 1/2-inch.
4. It is expected that in many instances increased depths over the minimum allowable will be required to permit the creation of shadow lines and otherwise allow for sculpturing and shaping of exposed surfaces. Design may require additional shotcrete to produce the desired results. The cost of placing this additional depth shall be included in the Bid.
5. Particular attention shall be made by the Contractor to the removal of rebound material. This material shall in no way be allowed to wash down the drainage facilities. All such materials are to be removed from the construction site as soon as possible.
6. Any construction joints in shotcrete shall be tapered off to a thin edge. Before shooting the adjacent section, the sloped portion shall be thoroughly cleaned with a 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.
7. Placing of Shotcrete:
    a. Whenever possible, except when enclosing reinforcing steel, the nozzle shall be held at right angles to the shotcrete surface at a distance of 2-1/2 to 3-1/2 feet. When enclosing steel, the nozzle shall be held so as to direct the material around the bars. A nozzlemans's helper equipped with an air jet shall attend the nozzleman and blow out all rebound, sand, etc., which may have lodged on the forms, steel or shotcrete. Shotcrete material shall emerge from the nozzle in a steady, uninterrupted flow. When flow becomes intermittent for any cause, the nozzle shall be diverted from the work until the flow again becomes constant. Hydration shall be thorough and uniform without the use of excessive water.
    b. In shooting walls, columns, beams, and/or trees, the application shall begin at the bottom and shall completely embed the reinforcement. The limit of the thickness and height has been exceeded when the material begins to sag. Particular care shall be given to formation of construction joints. They shall be sloped to a thin or square edge as required by the Engineer, and the entire joint shall be clean and thoroughly wetted before shotcrete is placed.
8. Finishing: Upon reaching thickness and shapes defined in Drawings, the surface will be textured as shown on Drawings or directed by Architect.
9. Curing: Shotcrete shall be damp cured for at least 7 days after placing or by proper application of an approved sealing compound. It shall be mandatory for the shotcrete contractor to perform the curing operation. No shotcrete shall be placed during freezing weather except when protective measures are taken as with ordinary concrete work. Shotcrete shall not be placed against frosted surfaces.

3.5 TESTING

A. At least 2 shotcrete cylinders for each 200 bags of cement used shall be made and cured. One cylinder shall be tested in 7 days and 1 in 28 days. The 28-day cylinders shall

develop at least 4,000 psi. Cylinders shall be made and tested by an approved testing laboratory, and copy of test data reports must be furnished to the Architect within 48 hours following the time tests were made. Contractor shall pay for all tests made. Should any test cylinders fail to meet the required 4,000 psi, the in-place work shall be tested as directed by the Architect/Owner, cost to be paid by the Contractor.

B. Defective work shall be removed and replaced at the Contractor's expense with no additional cost to Owner.

3.6 INSTALLATION OF ITEMS

A. Door frame adjacent to themework material shall be as indicated on Drawings.

3.7 WATERPROOF MEMBRANE

A. Install waterproof membrane per manufacturer's recommendations, at all locations where concrete and existing concrete masonry unit (CMU) materials will be exposed to, or immersed in, water.

3.8 INTEGRAL WATERPROOFING

A. Add Aquafin-IC Admix to shotcrete mix per manufacturer's recommendation, at all concrete or shotcrete installations exposed to, or immersed in water.

3.9 PROTECTION AND CLEANUP

A. Protect all surfaces adjacent to shotcrete work from damage during installation operations.

B. All drains, inlets, etc., shall be closed before shotcreting operation is started.

C. Particular attention shall be made by the Contractor to the removal of rebound material. This material shall in no way be allowed to be washed down the drainage facilities. All such materials shall be removed from the construction site as soon as possible.

D. Upon completion of the Work, the areas adjoining the site on which the Contractor has worked or over which vendors of materials shall have hauled or have worked shall be thoroughly cleaned of debris and refuse, and the areas restored to their original condition.

E. Protect finished Work from accumulation of dust, dirt and debris.

3.10 PHOTO REFERENCE

A. Photographs of representative natural features are included at the end of Section 03 37 13 for artistic guidelines to the types of features, details, colors, etc., to be used in the creation of the Artificial Rockwork.

B. Artificial Themework Contractor shall coordinate with Shotcrete Contractor for the creation of the artificial environments required in this facility, and for each of the represented animal species. Mock-ups of the Artificial Themework and represented environments shall be approved by the Owner and the Architect prior to further related activities and completion of the required Work.

END OF SECTION 03 37 20

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Manufacture, deliver, erect, and install precast concrete units specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.
   1. Product Data: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.
   2. Shop Drawings: Submit Shop Drawings showing information for fabrication and installation of precast concrete units. Indicate member dimensions and cross-section, location, size and type reinforcement, including special reinforcement and lifting devices necessary for handling and erection.
   3. Provide layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at openings in precast units.
   4. Provide location and details of anchorage devices that are embedded in related construction. Furnish templates if required for accurate placement.
   5. Include erection procedure for precast units and erection sequence.
   6. Provide manufacturer's complete design calculations prepared and stamped by registered engineer.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Furnish architectural precast concrete products complying with these specifications regarding physical requirements, workmanship, texture, and color.

B. Manufacturer: Regularly engaged in manufacture of this type product with inspection and quality control system and capability to produce precast units at rate that will not cause delays in Project.

C. Cast in accurate molds designed to withstand high frequency vibration.

D. Execute mix design, casting, finishing and curing using manufacturer's standard quality controlled production methods. However, the end product of any method must comply with all the aesthetic and physical characteristics specified.
   1. Cast method: Wet cast only; the vibrant dry tamp method is NOT acceptable.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver precast concrete units to Project Site in quantities and at times to assure continuity of installation. Store units at Project Site to ensure against cracking, distortion, staining, and physical damage, and so markings are visible. Lift and support units at designated lift points.

B. Deliver anchorage items which are embedded in related construction before start of related work. Provide setting diagrams, templates, instructions and directions required for installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mix Design Type I: Smooth
   1. Cement: 4 lb. white
   2. Fine Aggregate: 8 lb. Sheridan Masonry Sand
   3. Coarse Aggregate: 10.2 lb. 3/8" x #4 Harrison limestone
   4. Pigment 1: 17 grams #44 tan oxide pigment
   5. Pigment 2: 5.7 grams #638F brown pigment
   6. Surface Texture: Acid etch.

B. Reinforcement: Welded wire fabric with the addition of deformed reinforcing bars according to design criteria. Use galvanized deformed bars with one inch and less clearance to an exterior face.

C. Mechanical, electrical, special equipment and anchors, metal jambs and related items for work of other trades, if required, are supplied to manufacturer for casting into units by appropriate supplier under this Contract.

D. Anchorage devices, weld plates, inserts, wood nailers and lifting handles as furnished and securely embedded by manufacturer.

E. Sealant: Refer to Section 07 92 00 for material and installation requirements.

2.02 PHYSICAL QUALITIES

A. Concrete Mix: Design to have minimum compression strength of 5000 psi at 28 days when tested in 6" x 12" cylinders complying with ASTM C-39 latest revision. ASTM C109 Cube Testing Method is NOT acceptable.

B. Absorption: Not to exceed 5% maximum when tested complying with ASTM C-97 latest revision.

C. Water Cement Ratio: Not to exceed 5 gallons per sack of cement.

D. If mix designs with known test histories are used and semi-automatic batching equipment is employed, only certification of compliance to above is required. If test reports are requested by architect, same paid for by Owner.

E. Unit Tolerances:
   1. Warpage: Not to exceed 1/8" per 6'-0" length of panel.
   2. Squareness: No panel more than 1/8" in 6 feet off square.
   3. Location of Anchors and Inserts: Locate plus or minus 3/8" from center line of location required.
   4. Block-outs and Reinforcing. Locate within plus or minus 1/4" of positions required.

F. Reinforcing and connections shown on Drawings are adequate for normal temperature and building stresses. Manufacturer is responsible for additional reinforcing and connections necessary for fabrication, transportation, and erection stresses.

2.03 FINISH

A. Exposed Exterior Precast Concrete Unit Faces: Color and texture to be similar to cut limestone. Samples of Conway Precast, 443 Hwy 65 North, Conway, AR, 72032, (501) 329-8951 are on file at the office of the Architect and may be used for comparison.

PART 3 - EXECUTION

3.01 INSTALLATION

A. If installation is not performed by manufacturer, Contractor assumes full responsibility for the work. Employ skilled supervisors and workmen experienced in this type work.

B. Handle units in a nearly vertical plane at all times. Stack vertically and lean against proper supports until used, unless otherwise approved by manufacturer.

C. Center in their allotted space according to approved Shop Drawings and securely bolt or weld as required.

D. Protect units from staining during installation and after installation.

E. Rake back and seal joints complying with sealant specifications and details.

F. After work is completed, repair damaged architectural precast concrete products to satisfaction of Architect, and then wash down and clean entire surface with soap and clear water, preferably from a hose.

END OF SECTION 03 48 43

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Repair and filling of voids, holes and depressions in concrete.
   1. On grade, above and below grade, interior and exterior applications.
   2. Structural grouting of column base plates, machine base plates, anchor bolts, bearing plates, bridge seats, precast wall panels.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Dayton Superior Corporation, 1125 Byers Road, Miamisburg, OH 45342, Customer Service: 888-977-9600, Technical Services: 877-266-7732 www.daytonsuperior.com

2.02 MATERIALS

A. Non-Shrink, Non-Metallic Grout: Provide Dayton Superior 1107 Advantage Grout, a non-shrink, non metallic, non-corrosive, cementitious grout designed to provide a controlled, positive expansion to ensure an excellent bearing area.
   1. Meet ASTM C1107-20: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink).
   2. Approved equal manufacturers:
      a. MasterFlow® 555
      b. NS Grout, Euclid Chemical
      c. Sikagrout® 212
   3. Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing.

B. Patching Compound: Provide "All-Patch 20".

C. Feather Patch: Provide Polymer Modified Mortar Conspec “Feather Patch”, ChemMasters “FeatherPatch” or approved equal. For exterior (or interior) use and can be applied from feather edge to 1 inch per lift. May be used for horizontal, vertical and overhead surfaces. Install per manufacturer’s written recommendations and directions. Must be sealed immediately with water based curing and sealing compound, such as Polyseal™ WB, SafeSeal™ or Safe-Cure & Seal 20.

C. Two Component Acrylic Polymer Modified Topping and Underlayment: Provide PATCHCRETE® as manufactured by Lyons Manufacturing, Inc., 214-381-8100 or approved equal. Install per manufacturer’s written recommendations and directions.

D. Floor Topping: Provide Level Topping™ Exterior by Dayton Superior, or approved equal. Cement based, nonshrink, self-leveling topping for horizontal concrete designed for exterior use. This is not a gypsum based product.

PART 3 - EXECUTION

3.01 MIXING, PLACING AND FINISHING

A. Mix in accordance with the manufacturer's directions to consistencies required for application.

B. Level repaired surfaces flush with adjacent surfaces and trowel to a smooth finish.

END OF SECTION 03 60 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Pre-blended mortar mixes for use in indicated locations and types of masonry construction as specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 REFERENCE STANDARDS

A. ASTM International:
1. ASTM C91 - Standard Specification for Masonry Cement.
2. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
5. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
6. ASTM C476 - Standard Specification for Grout for Masonry
7. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
8. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
9. ASTM C1329 - Standard Specification for Mortar Cement.
10. ASTM C1384 - Standard Specification for Admixtures for Masonry Mortars.
11. ASTM E514 - Standard Test Method for Water Penetration and Leakage Through Masonry.
12. ASTM C 1357 - Standard Test Method for Evaluating Masonry Bond Strength.
13. ASTM C 1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
14. ASTM C 1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
15. ASTM C 1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar.
16. ASTM C 1019-20 - Standard Test Method for Sampling and Testing Grout for Masonry.

B. International Masonry Industry All-Weather Council (IMIAC):
   1. Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
   2. Recommended Practices and Guide Specification for Hot Weather Masonry Construction.

C. National Concrete Masonry Association (NCMA):
   1. NCMA TEK Bulletin #8-2A Removal of Stains from Concrete Masonry.
   2. NCMA TEK Bulletin #8-3A Control and Removal of Efflorescence.

1.04 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Samples: Submit selection and verification samples of mortar.

1.05 CLASSIFICATION OF MORTAR

A. Classification by Volume Measurements: Unless otherwise approved by Architect, conform to ASTM C 270 (or latest version), Table 1, for Cement-lime Mortar.

B. Classification by Test:
   1. Strength test, if required, determined with mortar prepared in laboratory selected by Architect or Owner, using representative materials and in proportions proposed for use. Preparation of and curing of mortar and test cubes shall conform to ASTM Specification C 270 of latest issue. Laboratory tests, if required, paid for by Contractor.
   2. Minimum Compressive Strength at End of 28 Days: Not less than that prescribed in ASTM C 270 (or latest version), Table 2, for Cement-lime Mortar.

PART 2 - PRODUCTS

2.01 MORTAR MATERIALS

A. Mortar Cement & Sand Masonry Mortar: SPEC MIX® Mortar Cement & Sand Masonry Mortar is a dry pre-blended mortar mix containing mortar cement and dried masonry sand formulated for superior bond, workability and board life.
   1. Mortar Type: M (2,500 psi).
   2. Mortar Type: S (1,800 psi).
   3. Applicable Standards: ASTM C 144, ASTM C 270, ASTM C 595, ASTM C 780, ASTM C 1072, ASTM C 1093, ASTM C 1157, ASTM C 1314, ASTM C 1329, ASTM C 1384, ASTM C 1586, ASTM C 1714, ACI 530.1, IMIAC.

B. Approved Manufacturers:
   1. Pro Mix® Masonry Mortar (Types S), as manufactured by Ash Grove Packaging, 315 Phillips Road, North Little Rock, AR 72117, 1-800-548-4219. For colored mortar provide ASH GROVE® Cement Color.
   2. Solomon Colors, Inc. SGS Concentrated Mortar Colors, 800-624-0261. Color to be selected from manufacturer's complete offering.

C. Basic Requirements: Conform to ASTM C 270 for materials, aggregate, and water and for storage, measurement, and mixing. Weights per cubic foot of materials in mortar are considered as follows:

D. Portland Cement: Type I or Type II conforming to ASTM C 150.

E. Sand: Clean sharp granules, free from loam, acids, alkalies, soluble salts, clay, or organic matter, conforming to ASTM C 144.

F. Quicklime for Lime Putty: Conform to ASTM C 5 with lime slaked and putty prepared in accordance with ASTM C 270. If hydrated lime is used conform to ASTM C 207, Type S.

G. Mortar for Laying Exterior Masonry: Waterproofed with Dry Block Mortar Admixture by Grace Construction Products.

2.02 ANTI-FREEZE ADMIXTURE

A. Mortar admixture for use when temperature drops below 50 deg.F.

B. Provide Conspec Q-Set, or approved equal.

2.03 GROUT FOR MASONRY SIGNIFICANCE AND USE (ASTM C1019-20)

A. Grout used in masonry is a fluid mixture of cementitious materials and aggregate with a high water content for ease of placement.

B. During construction, grout is placed within or between absorptive masonry units. Excess water must be removed from grout specimens in order to provide compressive strength test results more nearly indicative of the grout strength in the wall. In this test method, molds are made from masonry units having the same absorption and moisture content characteristics as those being used in the construction.

C. This test method is used to either help select grout proportions by comparing test values or as a quality control test for uniformity of grout preparation during construction.

D. The physical exposure condition and curing of the grout are not exactly reproduced, but this test method does subject the grout specimens to absorption conditions similar to those experienced by grout in the wall.

1. Test results of grout specimens taken from a wall should not be compared to test results obtained with this test method.

PART 3 - EXECUTION

3.01 MORTAR MIXING

A. Mix complying with manufacturer's instructions. Mix in batches for work immediately on hand. Measure by known capacity volume using barrow, buggy, manufacturer's packages, or related containers or by using approved batching device so specified proportions are consistently maintained. Do not use material that has partially set, been re-tempered, or used, frozen, caked, or become lumpy. Mix mortar with proper water amount for minimum of 3 minutes to desired consistency in batch mixer. Use mortar of as wet a consistency as can conveniently be handled. Do not use mortar which has greatly stiffened and in which cementing material has started to set. Do not re-temper mortar.

3.02 MORTAR USES

A. **Type N Mortar:** Type N mortar is suitable for general use in exposed masonry above grade. It is recommended for use in parapet walls, chimneys and exterior walls when subject to severe exposure.

B. **Type S Mortar:** Type S mortar is recommended for use in reinforced and unreinforced masonry where higher flexural strengths than Type N are required.

C. **Type M Mortar:** Type M mortar is recommended for use in masonry in contact with earth such as foundations, retaining walls, paving, sewers and manholes, and in reinforced masonry.

D **Type O Mortar:** Type O mortar is suitable for interior use in non-loadbearing applications.

END OF SECTION 04 05 13

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install specified joint reinforcement, anchors, ties, control joints, and related masonry accessories.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 PRODUCT HANDLING

A. Protection: Protect masonry accessory materials before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

A. CMU Joint Reinforcement: HB Lox-All® Truss Joint Reinforcement 120 Truss-Mesh Standard 9 Gauge Weight Hot-Dip Galvanized in size required or approved equal:
   1. Heckmann Building Products, 800-621-4140.
   2. Wire-Bond, Memphis, TN, 901-775-9444.

2.01 METAL ACCESSORIES

A. CMU Joint Reinforcement: Truss or Ladder type, high tensile strength, standard weight No. 9 steel rods in 10 ft. lengths, in appropriate width. Vertical spacing as shown on drawings.

B. Reinforcing Bars: Where shown, Grade 60 conforming to ASTM A 615.

2.02 FINISHES FOR METAL ACCESSORIES

A. Finish metal accessories according to the following requirements as set forth in ASCE6/ACI 530.1:
   1. Joint Reinforcement, Interior Wall: ASTM A641 Class 1
   2. Joint Reinforcement, wire ties or anchors,in exterior walls or interior walls exposed to moist environment: ASTM A153 Class B2
   3. Sheet metal ties or anchors completely embedded in mortar or grout: ASTM A525 Class G60
   4. Wire ties or anchors in interior walls: ASTM A641 Class 3
   5. Sheet metal ties and anchors in exterior walls or interior walls exposed to moist environment: ASTM A153

2.03 CONTROL JOINTS IN CONCRETE MASONRY UNITS

A. In addition to locations shown on drawings, locate control joints so that spacing does not exceed 1.5 times height of wall or 30'-0" o.c. for reinforced CMU or 25'-0" o.c. for non-reinforced CMU.

B. Provide preformed gaskets placed in sash grooves of concrete masonry using Dur-O-Wal D/A 2001/2025, or approved equal. Factory extrude from solid section of natural or synthetic rubber conforming to ASTM D-2000 2AA-805, with minimum curometer hardness of not less than 80 when tested in accordance with ASTM D 2240.

C. At exposed face of CMU, provide backer rod and sealant in addition to extruded sash groove control joint.

2.04 MASONRY INSULATION INSERTS

A. Provide KORFIL "U" shaped, flame-retardant treated expandable polystyrene insulation inserts with minimum density of 1.3 pcf and conforming to ASTM C578, Type X and ASTM C 90 as manufactured by Concrete Block Insulating Systems, Inc., 1-800-628-8476 or approved equal. www.cbisinc.com

PART 3 - EXECUTION

3.01 INSTALLATION OF MASONRY ACCESSORIES

A. Install masonry accessories at proper stages of masonry construction specified in Section 04 20 00 - Unit Masonry, and as required for performance of proper masonry workmanship.

B. Apply flashing to weather barrier system prior to and/or after installing cladding anchors per weather barrier manufacturer recommendations.

END OF SECTION 04 05 23

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish labor, tools, scaffolding, and required equipment, and materials for masonry construction specified and required to provide high quality masonry workmanship.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Qualifications of Workmen:
   1. For actual cutting and placing of masonry units, use skilled journeyman masons thoroughly experienced with materials and methods specified and thoroughly familiar with design requirements.
   2. Have one skilled journeyman mason present at all times during execution of work of this Section who shall personally direct and execute this portion of the Work.

1.05 SAMPLE FIELD PANELS

A. Erect a sample field panel for each of the following masonry materials required for this project:
   1. CMU: include special shapes, sills, single corner units, lintel units, solid cap units, and install a typical Control Joint at the center of the panel.
      a. Sills at interior openings may be 4" x 8" x 16" solid cap units or regular size Lintel units placed upside down to achieve flat and flush surfaces.
   2. Stone Materials.
   3. Precast Concrete Trim per Section 03 48 43.

B. Each sample panel is to be 6' long by 4' high. Use full size units to show color, color range, texture, bond, profile of joints, and workmanship. After approval, panel will be the standard for minimum workmanship and appearance requirements. Do not remove panel until authorized by Architect.

PART 2 - PRODUCTS

2.01 MATERIALS

A. **Materials:** Meet referenced ASTM Standards, with modifications specified herein.

B. **Lightweight Concrete Blocks (C33-1) and/or Normal Weight Concrete Blocks (C33):**

1. Use nominal 8" x 16" face, thickness required. Conform to ASTM C90 (Latest Edition), Type II. Use Type I at exterior if CMU is to be exposed to weather, for hollow loadbearing concrete masonry units and ASTM C129 (Latest Edition), Type II, for hollow non-loadbearing concrete masonry units. Cut blocks as required to form jambs, sills, and closers. Use normal weight blocks for below grade block work and at exterior block work that is exposed to weather. Lightweight block may be used at all other locations unless otherwise stated on Architectural or Structural Drawings. At Contractors expense, provide certification of ASTM C90 and C129 compliance from certified testing laboratory.
    a. All exterior concrete block to have Integral Water Repellant Masonry Unit admixture.
2. Provide standard "Sash Block" at locations where control and/or expansion joints are called for in CMU construction. Coordinate with control joint material specified in Section 04 05 23.
3. Provide units for fire resistant walls and partitions with fire resistance rating required according to UL Design numbers listed on drawings. Furnish rated product units by manufacturer listed in current Building Material List published by Underwriters Laboratories, LLC. In lieu of the above, units may be furnished on basis of examination and certified report by a recognized testing laboratory, indicating units are equivalent in fire resistance to those furnished by producers listed by Underwriters Laboratories, LLC. Examination shall cover width, height and length of block, shell web thicknesses, minimum equivalent thickness, compressive strength and type aggregate.
4. **Integral Water Repellant (IWR):** Liquid polymeric, admixture that does not reduce flexural bond strength.
    a. Basis of Design Product: RainBloc® Water Integral Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.

C. **Split Face Concrete Block:** Provide Normal Weight Concrete Blocks (C33), full split face unit in "Plain Gray" color. Block must conform to ASTM C90 (Latest Edition), Type II, for hollow loadbearing concrete masonry units and ASTM C129 (Latest Edition), Type II, for hollow non-loadbearing concrete masonry units and is to be manufactured with recommended amount of integral water repellant DRY-BLOCK® System Admixture, as

manufactured by Grace Construction Products or approved equal. Block must be manufactured with 3000 psi (net area)/1300 psi (gross area) concrete. Contractor to verify and submit test report to Architect. Provide "Sash Block" at locations where control and/or expansion joints are called for in CMU construction. Coordinate with control joint material specified in Section 04 05 23.

D. **Reinforced CMU Construction:** Conform to the provisions of ANSI A41.2 (NBS Handbook 74) and/or ACI/ASCE 530.

E. **Packaged Materials:** Provide mortar materials specified in Section 04 05 13. Provide masonry accessories specified in Section 04 05 23. Deliver and store packaged materials, including cement, in original packages plainly marked with brand and maker's name. Materials in broken containers and in packages showing water marks and evidence of damage will be wholly rejected. **Mortar color shall be selected by the architect.** MATCH EXISTING COLORED MORTAR.

F. **Concrete Fill:** Fill voids in concrete block where required with structural masonry grout complying with ASTM C476 and ASTM C404. Refer to NCMA TEK 09-04A and TEK 3-2A. Grout may be Fine or Course depending on use. Do not use mortar for this purpose.

2.02 MASONRY CLEANERS

A. Products approved for use are Sure Klean® 600 Detergent.
   1. 101 Lime Solvent for dark-colored brick and tile surfaces.
   2. Sure Klean® Vana Trol® acidic cleaner for new masonry surfaces.
   3. EaCo Chem NMD 80 buffered acid-based new masonry cleaner.

B. Provide products by ProSoCo®, Enviro Klean® Safety Klean, alternative to traditional acidic compounds.

C. Consult masonry manufacturer and ProSoCo Technical Service prior to applying any cleaner. Some cleaners are not suited for use on certain masonry units and may cause damage that will be repaired or replaced at Contractor's expense.

2.03 FLEXIBLE FLASHING

A. Provide **Rhino-Bond** 40 mil peel and stick no-drool flashing by Wire-Bond®, or approved equal. Use termination bar for securing flashing to structure where required at surface-mount substrates incompatible with membrane adhesive.

PART 3 - EXECUTION

3.01 LAYING CONCRETE BLOCK

A. Lay blocks straight, plumb, and in perfect alignment. Protect concrete blocks from weather by covering during storage and after laying. Before using blocks, dry them to

moisture content of approximately the average air-dry condition to which finished walls will be exposed. Take care to keep mortar off face surface of exposed blocks. At end of job, clean exposed block walls. Where necessary to fit around wall switches and openings, cut blocks to neat line with power saw. Refer to drawings for spacing and type of reinforcement and anchors required.

B. Lay block in 1/2 bond, with mortar finished using a round tool giving concave joints. Nominal thickness of all joints is 3/8" and uniform.

3.02 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within the tolerances specified.

B. Maximum variation from plumb:
   1. In 10 feet: 1/4 inch
   2. In 20 feet: 3/8 inch
   3. In 40 feet or more: 1/2 inch

C. Maximum variation from level:
   1. In any bay or up to 20 feet: 1/4 inch
   2. In 40 feet or more: 1/2 inch

D. Maximum variation from linear building lines:
   1. In any bay or up to 20 feet: 1/2 inch
   2. In 40 feet or more: 3/4 inch

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
   1. Minus 1/4 inch
   2. Plus 1/2 inch

F. Maximum variation in prepared opening dimensions:
   1. Accurate to minus 0 inch
   2. Plus 1/4 inch

3.03 PROTECTION OF OPEN CAVITY WALLS DURING CONSTRUCTION

A. Protection:
   1. All exposed openings in CMU construction shall be protected during the erection process to prevent water from entering, especially at the tops of walls, and settling within interior cavities causing leaching and other damaging occurrences resulting from capillary action. Secure temporary waterproof membranes at the end of each day's work to prevent rain and snow from entering the cores and cavities. Planks laid on the wall are not considered adequate cover.
   2. Refer to the Portland Cement Association publication "Recommended Practices for Laying Concrete Block".

3.04 INSTALLING FLEXIBLE FLASHING

A. Install continuous flexible flashing. Lap material at joints minimum 6" and tightly seal with mastic. Spot bonding of mastic equal to 25% of the flashing area applied at 12 inch intervals is acceptable. Apply mastic by trowel at rate of 50 square feet per gallon unless otherwise shown on the container.
   1. Where exposed portions are used as a counter-flashing, lap base flashing at least four inches.
   2. Terminate exterior edge beyond face of wall approximately 1/4-inch.
   3. Turn back edge up 8 inches unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
   4. Terminate interior raised edge in masonry backup unit approximately 2 inches into unit unless shown otherwise.
   5. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound.
   6. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
   7. Where ends of flashing terminate turn ends up 2 inch and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
   8. Turn flashing up not less than 8 inches between masonry wythes or behind exterior veneer.

3.05 BUILT-IN ITEMS

A. Build in wood blocks, strips, wedges, frames, loose lintels, miscellaneous iron and other items furnished by other subcontractors and which may be required for properly securing their work.

3.06 FREEZING WEATHER

A. Do not lay masonry when outside air temperature is below 40 degrees F., unless suitable means are provided to heat masonry materials and to protect completed work from freezing for at least 48 hours.

3.07 CLEANING PREMISES

A. Mason Contractor: Remove rubbish and building materials left over from operations under his charge, whenever directed by General Constructor. Premises must be left clear and clean. When buildings are completed, completely remove mortar droppings.

3.08 BOND BEAMS

A. Reinforce bond beams as required and fill with 3,000 psi. minimum compressive 28-day strength concrete, unless shown otherwise on structural drawings. Do not use masonry mortar for this purpose.

3.09 POINTING AND CLEANING

A. Cut out defective mortar joints. Refill solidly with mortar and tool to match adjacent work.

B. On completion clean exposed masonry, removing foreign material, excess mortar and stains. Apply cleaning solution to sample area of approximately 20 square feet at an inconspicuous location approved by Architect. Use cleaning solution specially manufactured for this purpose, applying in accordance with manufacturer's directions. Drench masonry with clean water before applying solution, and after cleaning, rinse with clean water to remove all traces of solution. Protect materials adjacent to masonry from contact with cleaning solution.

C. High Pressure Water Cleaning: **This method of cleaning will not be allowed on masonry surfaces unless approved by architect and masonry manufacturer.** High pressure water is to be used to saturate the masonry before cleaning takes place and may be used to rinse away cleaning solution and foreign particles after cleaning is complete. Allow mortar to cure for a minimum of seven (7) days before subjecting it to high pressure cleaning. After consulting with Architect and manufacturer for cleaning recommendations, test clean a sample panel of all the materials selected for the work. Apply water at a pressure ranging from 300-500 psi (not to exceed 800 psi). Provide a flow rate of water between 3 and 6 gallons per minute through a "Fan" type, stainless steel tip dispersing a 25° to 50° fan spray. Do not use less than 15° fan spray tip. Application of acidic cleaning compounds through the high pressure system will not be allowed. Do not apply sealer until masonry is completely dry and cleaning has been reviewed by Architect.

END OF SECTION 04 20 00

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Shop-applied coatings for architectural metals.

B. Related sections:
   1. Division Section 05 50 00 - Metal Fabrications.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 621 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
   2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
   3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions.
   4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions.

B. ASTM International (ASTM):
   1. ASTM B 117 - Practice for Operating Salt Spray (Fog) Apparatus.
   2. ASTM G 85 annex 5 – Modified Salt Spray Cyclic Fog Test
   3. ASTM D 7901 - Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base.
   4. ASTM D 1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

5. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
6. ASTM D 2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
7. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test.
8. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
9. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

1.05 PERFORMANCE REQUIREMENTS

A. Solar Reflective Index: Provide metal roof panel coatings with solar reflectance index of not less than 78 for slopes of 2:12 or less and 29 for slopes greater than 2:12, per ASTM E 1980.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: Coating manufacturer's approved Applicator who is equipped, trained and approved for application of coatings required for this Project, and is approved to provide warranty specified in this Section.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, unload, and store shop-coated items so that they remain free of damage or deformation. Package and protect items during shipping and handling. Protect stored items from water; stack to facilitate drainage. Keep shop-coated items out of contact with materials that may adversely affect the coating.

B. Protect shop-coated items with protective covering until installed.

1.08 COORDINATION

A. Coordinate submittal and selection procedures for items to receive shop-applied coatings. Where items are indicated to match coatings selected for other items, adjust formulations as required to achieve match. Submit samples for verification indicating compliance with matching requirements.

1.09 WARRANTY

A. Coating Warranty: Coating Applicator's warranty in which Applicator agrees to repair finish or replace coated items that demonstrate deterioration of shop-applied finishes within warranty period indicated.
   1. Exposed Coating: Deterioration includes but is not limited to:
      a. Color fading in excess of 5 Delta E Hunter units per ASTM D 2244.
      b. Peeling, checking, or cracking of coating adhesion to metal.
      c. Chalking in excess of a No. 8 per ASTM D 4214, when tested per Method D 659.

d. Corrosion of substrate in excess of a No. 6 on cut edges and a No. 8 on field surfaces, when measured per ASTM D 1654.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Provide shop-applied coatings manufactured by PPG Industries, Inc., Pittsburgh, PA, (888) 774-4332, Email: ideascapes@ppg.com; Website: www.ppgideascapes.com or comparable products of another manufacturer approved by Architect prior to bid.

2.02 APPROVED COATING APPLICATORS

A. Acceptable Applicators: Provide shop-applied coatings applied by one of the following manufacturer-approved applicators:
   1. Arkansas Powder Coating & Industrial Blasting, (501) 222-4454.
   2. Arkansas Powder Coat, Paragould, AR. (870) 450-0147.
   3. Martin Specialty Coatings, Hot Springs, AR. (800) 828-3754.

2.03 HIGH-PERFORMANCE ORGANIC FINISH MATERIALS - EXTRUSIONS

A. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605: Minimum 70 percent PVDF resin, by weight, in color coat and clear topcoat.
   1. Product: PPG Industries, Inc..
   2. Pencil Hardness, ASTM D 3363: F, minimum.
   3. Salt Spray Resistance – ASTM G 85 – 2,000 hours
   4. Humidity – ASTM D 2247 – 1,000 hours
   5. Dry Film Thickness, ASTM D 1400: 0.20mil primer coat plus 1.0 mil color coat, 1.20 mil total, minimum thickness.
   6. Dry Film Thickness, ASTM D 1400: 0.20 mil primer coat plus [1.0 mil barrier coat,] 1.0 mil color coat and 0.4 mil clear topcoat, [1.6 mil] [2.6 mil] total, minimum thickness.

B. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2604: 50% PVDF resin, by weight, in color coat.
   1. Product: PPG Industries, Inc., Acrynar
   2. Pencil Hardness, ASTM D 3363: F, minimum.
   3. Salt Spray Resistance – ASTM B117
   4. Humidity
   5. Dry Film Thickness, ASTM D 7901: 0.20 mil primer coat plus 1.0 mil color coat, 1.2 mil total, minimum thickness.

2.04 POWDER COATING MATERIALS - EXTRUSIONS

A. Powder Coatings, Fluoropolymer, meeting performance requirements of AAMA 2605:
   1. Product: PPG Industries, Inc., Duranar Powder Coating.
   2. Pencil Hardness, ASTM D 3363: F, minimum.
   3. Salt Spray Resistance, ASTM G 85: 2,000 hours.
   4. Humidity Resistance, ASTM D 2247: 4,000 hours.
   5. Dry Film Thickness, ASTM D 7901: 0.20-0.30 mil primer coat plus 1.5 to 2.5 mil Duranar Powder Topcoat, 1.7 mil total, minimum thickness.

B. Powder Coatings, Fluoropolymer, meeting performance requirements of AAMA 2605:
   1. Product: PPG Industries, Inc., Coraflon Powder Coating.
   2. Pencil Hardness, ASTM D 3363: F, minimum.
   3. Salt Spray Resistance, ASTM G 85: 2,000 hours.
   4. Humidity Resistance, ASTM D 2247: 4,000 hours.
   5. Dry Film Thickness, ASTM D 7901: [2.0] mil, minimum thickness.

C. Powder Coatings, Polyester, meeting performance requirements of AAMA 2604.
   1. Product: PPG Industries, Inc., Envirocron 04 Ultra-Durable Powder Coating.
   2. Pencil Hardness, ASTM D 3363: H – 2H.
   3. Salt Spray Resistance, ASTM B 117: 3,000 hours.
   4. Humidity Resistance, ASTM D 2247: 3,000 hours.
   5. Dry Film Thickness, ASTM D 7901: [2.0] mil, minimum thickness.

2.05 FINISHES

A. Pretreatment: Mechanically clean and chemically pretreat fabricated items in accordance with coating manufacturer's requirements and AAMA requirements for finish indicated.

B. Application: Apply primer and finish coats in accordance with coating manufacturer's requirements for finish indicated.

2.06 SHOP-APPLIED COATINGS SCHEDULE

A. High-Performance Organic Finish for Aluminum Extruded Items: 2-coat fluoropolymer finish: AAMA 2604.
   1. Coated Items: Refer to the drawings.
   2. Color: As selected from manufacturer's full range.
   3. Gloss: As selected from manufacturer's full range.

B. High-Performance Organic Finish for Aluminum Sheet Items: 2-coat fluoropolymer finish: AAMA 2605.
   1. Coated Items: Refer to the drawings.
   2. Color: As selected from manufacturer's full range.
   3. Gloss: As selected from manufacturer's full range.
   4. Concealed/ Backer Finish: Pretreat substrate and apply coating applicator's standard acrylic, polyester or epoxy finish in accordance with manufacturers’ requirements.

C. High-Performance Organic Finish for Steel Sheet Items: 2-coat fluoropolymer finish: AAMA 621.
1. Coated Items: Refer to the drawings.
2. Color: As selected from manufacturer's full range.
3. Gloss: As selected from manufacturer's full range.
4. Concealed/ Backer Finish: Pretreat substrate and apply coating applicator's standard acrylic, polyester or epoxy finish in accordance with manufacturers' requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to individual specifications sections for installation requirements for items receiving shop-applied coatings.

3.02 PROTECTION

A. Remove protective wrap from coated items at time of installation.

END OF SECTION 05 05 13

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PART 1 - GENERAL

1.01 WORK INCLUDED

A. Degreasing surfaces

B. Surface profiling

C. Washing and rinsing

D. Steel, including shop-fabricated bollards, in or near direct contact with grade or not protected by substantial roof or canopy overhang.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. Publications
   1. American Galvanizers Association (AGA):
      Inspection of Products Hot-Dip Galvanized After Fabrication
      Duplex Systems: Painting Over Hot-Dip Galvanized Steel

   2. Elsevier, van Eijnsbergen, J.F.H., New York, 1994: *Duplex Systems - Hot-Dip Galvanizing Plus Painting Wet Storage Stain*

B. Reference Standards
   1. American Society for Testing and Materials (ASTM):
      A 123/123M Zinc (Hot-Dip Galavanized) Coatings on Iron and Steel Products

      A 153/153M Zinc (Hot-Dip Galavanized) Coatings on Iron and Steel Products

      A 780 Repair of Damaged Hot-Dip Galvanized Coatings

D 6386 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

D 7803 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating

1.05 QUALITY ASSURANCE

A. Coating Applicator: Company specializing in painting or Hot-Dip Galvanizing after fabrication.

1.06 DELIVERY, STORAGE AND HANDLING

A. Load and store galvanized articles in accordance with accepted industry standards.

PART 2 - PRODUCTS

2.01 ACCEPTABLE SURFACE PREPARERS

A. Members of the American Galvanizers Association or equal, such as painting contractors, approved by the design professional.

2.02 HOT-DIP GALVANIZED MATERIALS

A. Material for surface preparation suitable for painting is required to be Hot-Dip galvanized as described in ASTM A123/A 123M and A 153/A 153M. Hot-Dip galvanized articles and fabrications may be newly galvanized, partially galvanized or completely weathered.

2.03 HOT-DIP GALVANIZING REQUIREMENTS

A. Hot-Dip galvanizing practices shall be in accordance with the applicable portions of ASTM A123/A 123M or A 153/A 153M.

B. Water quenching or chromate quenching conversion coating should be avoided as these processes interfere with paint adhesion and surface preparation.

PART 3 - EXECUTION

3.01 SURFACE SMOOTHING

The following process should only be used if high spots of zinc are visible on the parts to be painted.

A. Zinc high spots, such as a metal drip line, should be removed by cleaning with hand or power tools as described in SSPC Surface Preparation Specification 2 or 3. The zinc should be removed until it is level with the surrounding area, taking care that the base coating is not removed by the cleaning methods.

B. After cleaning, the surface shall be inspected for conformance to the required zinc thickness in accordance with ASTM A123/A 123M or A 153/A 153M utilizing a magnetic-field-type thickness instrument in accordance with ASTM E 376. Any item falling below the required zinc thickness, before or after removal of any high spots, shall be repaired in accordance with ASTM A 780.

3.02 AQUEOUS ALKALINE CLEANING

This surface cleaning is required for all galvanized steel parts, except for those that have been galvanized less than 24 hours.

A. An alkaline solution, pH in the range of 11 to 12 but not greater than 13, can be used to remove traces of oil, grease or dirt.

B. This solution can be applied through immersion in a tank filled with the solution, sprayed on, or brushed on with a soft bristle brush, usually nylon and not steel or copper.

C. When dipping or spraying, the solution works best in the temperature range from 60 to 85 C (140 to 185F).

D. After cleaning, rinse thoroughly in hot water under pressure. Allow to dry completely before proceeding.

3.03 SOLVENT CLEANING

This is an alternative to Section 3.02.

A. Typical cleaning solvents, such as mineral spirits or high-flash naptha, can be used to remove oil and grease. The procedure to be used is as specified in SSPC Surface Preparation Specification 1.

B. Proper rags or brushes should be used to wipe galvanized parts. Small parts may be dipped or cleaned in ultrasonic baths of solvents.

C. After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding.

3.04 HAND OR POWER-TOOL CLEANING

The following process should be used only if there is visible evidence of wet storage stain on the galvanized surface.

A. Hand or power-tool cleaning may be used to clean light deposits of zinc reaction by-products, such as wet storage stain, as specified in SSPC Surface Preparation Specification 2 or 3.

3.05 SWEEP BLASTING

This process is required for all galvanized parts, except those that have been exposed to the environment for more than one year.

A. Abrasive sweep or brush blasting which uses a rapid nozzle movement will roughen the galvanized surface profile. The abrasive material must be chosen with care to provide a stripping action without remove excess zinc layers. Follow the procedures detailed in ASTM D 6386 for abrasive sweep blasting.

B. Following abrasive blast cleaning, surfaces should be blown down with clean compressed air.

3.06 ZINC PHOSPHATE TREATMENT

This is an alternate process for Section 3.05.

A. This conversion-coating process consists of treating the newly galvanized zinc surface with an acidic zinc phosphate solution containing oxidizing agents and other salts for accelerating the conversion action. Follow the procedures detailed in ASTM D 6386 for zinc phosphate treatment.

B. After 3 to 6 minutes, the surface should be washed with clean water and allowed to completely dry before application of the paint system.

3.07 WASH PRIMER TREATMENT

This is an alternate process for Section 3.05.

A. This process involves the use of metal conditioner to neutralize surface oxides and hydroxides and to etch the surface. Follow the procedures detailed in ASTM D 6386 for wash primer treatment.

B. For drying time prior to top coating, follow the manufacturer's instructions. This wash-primer treatment may be better suited to certain types of paint systems.

3.08 ACRYLIC PASSIVATION/PRETREATMENT

This is an alternate process for Section 3.05.

A. The passivation/pretreatment process consists of applying an acidic acrylic solution to the newly galvanized surface and then allowing it to dry, forming a thin film coating. Follow procedures detailed in ASTM D 6386 for acrylic passivation/pretreatment.

B. Painting is possible any time during a period of four months after application as long as the surface is free of visible zinc oxides or zinc hydroxides.

3.09 REPAIR OF DAMAGED COATING

The following process should be used only if there is visible damage to the zinc coating.

A. The maximum area to be repaired is defined in accordance with ASTM A 123/A 123 M Section 6.2, current edition.
   1. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

B. Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in ASTM A 123/A 123M Section 6.2 current edition.

END OF SECTION 05 05 16

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and erect specified steel framing, column bases, lintels and related structural steel shapes and accessories.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

B. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs and ladders, steel joists and joist girders, cold-formed metal framing, and metal deck are specified elsewhere in these Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

1. Furnish Shop Drawings, for review by Architect, on structural steel showing necessary fabrication details, fittings, fastenings, anchorage and erection details. In addition to provisions of the General Conditions, prepare structural steel Shop Drawings by or under the supervision of a registered professional engineer. Do not use reproductions, in any form, of the Contract Drawings for Shop Drawings. Furnish two prints of Shop Drawings submitted to Architect for review. Submit related shop drawings together; partial submittals will not be accepted. Furnish mill certificates on foreign steel proposed for use and not produced within the continental USA. Include with mill certificates certified copies of mill test reports giving names and locations of mills and shops, and chemical analysis and physical properties of steel required for this project.
   a. Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Only conventional, paper reproductions of such information will be made available to parties listed above.
2. All drawings shall bear the stamp of a structural engineer licensed in the state in which the project is located.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Codes and Standards: In addition to complying with pertinent codes and regulations, comply with:
   1. AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", Latest Edition.
   2. AISC "Code of Standard Practice", Latest Edition.
   3. AISC "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design", Latest Edition.
   4. AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings", Latest Edition.
   5. "Code for Welding in Building Construction" of the American Welding Society.
   6. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction.
   7. Steel Structures Painting Council (SSPC): Painting Manual, Vol. 1, Good Painting Practice. Painting Manual, Vol. 2, Systems and Specifications.
   8. Conform to ASTM A 6, "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
   9. AISC “Architecturally Exposed Structural Steel (AESS)”, Latest Edition. Refer to AISC Code of Standard Practice (ANSI/AISC 303-22). AESS can fall within the following five categories:
      a. AESS 1: Basic Elements
      b. AESS 2: Feature Elements Not in Close View
      c. AESS 3: Feature Elements in Close View
      d. AESS 4: Showcase Elements
      e. AESS C: Custom Elements

B. Conflicting Requirements: In event of conflict between pertinent codes and regulations and requirements of referenced standards or these specifications, provisions of more stringent govern.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL

A. Steel Shapes: Provide structural steel shapes, not otherwise indicated on Structural Drawings using high-strength steel, 50 ksi minimum yield strength, conforming to ASTM A992.

B. Pipe Columns: ASTM A501, Fy = 36 ksi. or A53, Type E, Fy = 35 ksi

C. Rectangular HSS: ASTM A500, Grade B (Fy=46 ksi) or have equal yield, ultimate, and weldability properties.

D. Round HSS: ASTM A500, Grade B (Fy=42 ksi) or have equal yield, ultimate, and weldability properties.

E. Steel Plates, Channels and Angles: ASTM A36, 36 ksi minimum yield strength.

F. Headed Stud Shear Connectors: ASTM A108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC Specifications.

G. Furnish structural steel for this Project manufactured within continental limits of the United States of America unless mill certificates are submitted to and approved by Structural Engineer.

2.02 BOLTS AND NUTS

A. High Strength Bolts:
   1. Meet ASTM A 325 for high strength bolts.
   2. Make bolt holes 1/16 inch larger than nominal bolt diameter.
   3. Threads may be included in shear plane of bolts.

B. Machine Bolts and Anchor Bolts: Meet ASTM A307 and A449.

C. Bolted Truss Connections: ASTM A325, slip critical in oversize round holes.

2.03 SHOP PRIMER

A. Lead free, alkyd primer: Manufacturer's standard.

2.04 OTHER MATERIALS

A. For materials, not specifically described but required for complete and proper installation of structural steel, use new material, free from rust, first quality of their respective kinds, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 MEASUREMENT AND DIMENSIONS

A. Contractor to verify measurements and dimensions at job site. Bring any conflict between actual measurements and dimensions shown on the Drawings and any existing condition which will prevent fabrication and erection of steel work as detailed to attention of Architect as soon as they are discovered. Contractor responsible for errors of Shop Drawings, fabrication, correct fitting, and alignment of the structural members. Shop or field splices in standard structural rolled shapes not acceptable unless shown on Contract Drawings.

3.02 WORKMANSHIP

A. Fabricate and erect to comply with the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and the "Code of Standard Practice" as adopted by the American Institute of Steel Construction.

3.03 SHOP PRIMER

A. For surface preparation, shop painting and touch-up painting of structural steel shapes, conform to the "Steel Structures Painting Manual", Volumes 1 and 2, of the Steel Structures Painting Council.

3.04 WELDING

A. Shop and field welders continuously employed as welders are acceptable on basis of satisfactory reports dated not more than 2 years prior to award of this Contract. All others must have been re-qualified in past 6 months complying with AWS D 1.0, Appendix.

3.05 LINTELS

A. Furnish and place all structural steel lintels required for all openings unless concrete lintels or reinforced concrete block lintels are shown on Drawings. Build structural members size marked on Drawings or if not shown as determined by the Structural Engineer. Weld members together with exterior weld being a continuous bead to prevent water from running between the members. Bear on walls 8 inches at each end for openings up to 6'-0" wide and 10 inches for wider openings where not otherwise shown.

3.06 HIGH-STRENGTH BOLTING

A. Comply with the "Specification of Structural Joints" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation using calibrated-wrench tightening or turn-of-nut tightening methods. By either method, use a calibrating device to check tools and equipment and to provide means of reliable inspection. When turn-of-nut method tightening is used to provide bolt tension complying with ASTM A325, match-mark outer face of nut with the protruding bolt point before final tightening for visual means of noting actual nut rotation. Above marks may be made by wrench operator with crayon or daub of paint, after bolts have been brought to "snug tight" condition.

3.07 INSPECTION

A. Engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements and specifically state any deviations.

C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that inspection and testing can be accomplished.

D. Testing agency may inspect structural steel at plant before shipment.

E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

F. Shop Bolted Connections: Inspect or test in accordance with AISC specifications.

G. Shop Welding: Inspect and test during the fabrication or structural steel assemblies, as follows:
   1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Perform visual inspections of all welds.
   3. Perform tests of welds as follows. Inspection procedures listed are to be used at Contractor's option.
      a. Liquid Penetrant Inspection: ASTM E165 or Magnetic Particle Inspection, ASTM E709, performed on root pass and on finished weld on ten percent of fillet welds. Cracks or zones of incomplete fusion or penetration are not acceptable.
      b. Radiographic Inspection: ASTM E94 and ASTM E142, minimum quality level "202T" or Ultrasonic Inspection: ASTM E164 on 50 percent of full penetration welds.

H. Field Welding: Inspect and test during erection of structural steel as follows:
   1. Certify welders and conduit inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   2. Perform visual inspections of all welds.
   3. Perform tests of welds as follows.
      a. Liquid Penetrant Inspection: ASTM E165 or Magnetic Particle Inspection, ASTM E709, performed on root pass and on finished weld on ten percent of fillet welds. Cracks or zones of incomplete fusion or penetration are not acceptable.
      b. Radiographic Inspection: ASTM E94 and ASTM E142, minimum quality level "202T" or Ultrasonic Inspection: ASTM E164 on 50 percent of full penetration welds

3.08 ERECTION

A. Use Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings of AISC except as otherwise specified.

B. Sequence: Contractor responsible for erection method and sequence.

C. Progress: As erection progresses, secure the work to take care of dead loads, wind, and erection stresses. Where structural steel is being erected, completely connect the in-place work in the tier below. **Not more than four stories of steel may be erected above the**

story in which all final structural connections have been made.

D. Alignment: After erection, accurately align and adjust the various members forming parts of a completed frame and structure before being made secure.

E. Tolerances: AISC Code of Standard Practice apply except as otherwise specified.

F. Erection Shims: Sufficient shims may be installed to maintain structure within tolerances. Maximum shim thickness at any one joint no greater than 1/2-inch.

G. Field Assembly: Provide even bearing at field erected column splices and related compression joints which depend upon contact bearing upon completion with respect to the centroid of the contact area. Provide at least 65 percent of the entire contact area in full bearing and the separation of any remaining portion not to exceed 0.02 inches, except locally at toes of flanges where a 50 percent greater separation is permissible; otherwise perform corrective measures.

H. Anchors: Locate and install anchor bolts and anchors, preset by templates, into connecting work. Provide bearing plates under ends of primary structural members resting on masonry and set in full beds of non-shrink grout.

I. Base Plates: Support and align column base plates on steel leveling devices. After support members have been plumbed and properly positioned and anchor nuts tightened, pack solidly entire bearing area under plate with non-shrink grout specified in "Concrete" Division of these Specifications. Leave leveling devices in place and cut off flush with edge of column base plates.

J. All welds, cut edges and areas where primer is missing or damaged is to be cleaned and re-primed.

END OF SECTION 05 10 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install miscellaneous metal items required and specified. Provide miscellaneous bolts, anchors, supports, braces, and connections necessary for completion of Work.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.
   1. Submit Shop Drawings on miscellaneous metal items for review by Architect, prior to fabrication. Include type, grade, class of metal and sizes, details of fabrication, methods of assembling, connections to supporting construction, reinforcement, and location of hardware.
      a. Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Only conventional, paper reproductions of such information will be made available to parties listed above.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. Specifications for the Design, Fabrication and Erection of Structural Steel for Building

B. American National Standards Institute (ANSI):
   1. ANSI A14.3, "Ladders, Fixed, Safety Requirements."

C. American Society for Testing and Materials (ASTM):
   1. ASTM A36, "Structural Steel."
   2. ASTM A53, "Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe."
   3. ASTM A123, "Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products."
   4. ASTM A153, "Zinc Coating (Hot-Dip) on Iron and Steel Hardware."
   5. ASTM A307, "Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength."
   6. ASTM A446, "Specification for Sheet Steel, Zinc-Coated by the Hot-Dip Process."
   7. ASTM A500, "Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes."
   8. ASTM A568, "Specification for General Requirements for Steel, Carbon and High-Strength Low Alloy Hot-Rolled Sheet and Cold Rolled Sheet."
   9. ASTM A627, "Specification for Homogeneous Tool-Resisting Steel Bars for Security Applications.
   10. ASTM A780, "Practice for Repair of Damaged Hot-Dipped Galvanized Coatings."
   11. ASTM B221, "Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube."

D. American Welding Society (AWS):
   1. AWS D1.1 - Structural Welding Code.

E. Steel Structures Painting Council Specification (SSPC):
   1. Steel Structures Painting Manual.

1.05 QUALITY ASSURANCE

A. Qualifications of Welders: Use certified welders and the shielded arc process for welding performed in connection with work of this Section.

B. Codes and Standards: In addition to complying with pertinent codes and regulations, comply with:
   1. "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
   2. "Code for Welding in Building Construction" of the American Welding Society.

C. Conflicting Requirements: In event of conflict between pertinent codes and regulations, requirements of the referenced standards, and these specifications, provisions of more stringent govern.

D. Design, engineer, fabricate and install handrails and railing systems to comply with requirements of ASTM E985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935. Conform to the current version of the IBC.

E. Handrails, guardrails, and their supports to be designed for 50 lbs per linear foot, applied in any direction at the top of the top rail, and a concentrated load of 200 lb applied in any direction at any location along the top of the rail. The uniform load and concentrated loads are not to be applied simultaneously. Other components, including guardrail infill and bottom rails, are to be designed for 100 lbs acting on a projected area of 1 square foot, including the open space between components. The effects of this load are not to be combined with the load on the top rail.

F. ASTM E 985 - For railing - related definitions and structural performance criteria.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel plates, angles, and other structural shapes shall conform to ASTM A36.

B. Steel pipe shall conform to ASTM A53, Grade B, Schedule 40.

C. Galvanized steel pipe and tube shall conform to ASTM A53.

D. Steel Tubing shall conform to ASTM A500.

E. Sheet Steel, Galvanized: ASTM A446.

F. Sheet and Strip Steel, Hot Rolled: ASTM A568.

G. Extruded Aluminum: ASTM B221.

H. Anchors and Fasteners for Aluminum: Stainless steel.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Anchors
   1. Threaded Type Concrete Inserts: Galvanized malleable iron or cast steel capable of receiving 3/4 inch diameter machine bolts.
   2. Slotted Type Concrete Inserts: Welded box type fabricated with minimum 1/8 inch thick galvanized pressed steel plate with slot to receive 3/4 inch diameter square head bolt and knockout cover.
   3. Expansion Shield for Masonry Anchorage: FS FF-2-325.
   4. Toggle Bolts: FS FF-B-588.

K. Fasteners
   1. Bolts, Nuts and Washers for Exterior Locations: ASTM A307, galvanized in accordance with ASTM A153.
   2. Bolts, Nuts and Washers for Interior Locations: ASTM A307, Grade A, regular hexagon head.

3. Bolts, Round Head: ANSI B-18.5
4. Wood Screws, Flat Head Carbon Steel: ANSI B-18.6.1.
5. Plain Washers, Helical Spring Type Carbon Steel: FS FF-W-84.

2.02 FABRICATION

A. Fabricate steel items according to approved shop drawings and to applicable portions of AISC Specifications. Conceal welds where possible; grind exposed welds smooth and flush with adjacent finished surface. Ease exposed edges to small uniform radius.

B. Pre-assemble products in shop to greatest extent possible. Disassemble units to extent necessary for shipping and handling. Clearly mark units for re-assemble and installation.

C. For exposed to view fabrications, use materials which are smooth and free of surface blemishes including pitting, seams marks, roller marks, roller trade names and roughness. Remove blemishes by grinding or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coating.

D. Fabricate items with joints tightly fitted and secured.

E. Fit and shop assemble in largest practical sections for delivery to Project site.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.

G. Make exposed joints butt tight, flush and hairline.

H. Fabricate anchorage and related components of same material and finish as metal fabrication, unless indicated otherwise.

2.03 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.

B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.04 LOOSE STEEL LINTELS

A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.

D. All steel lintels shall be coated with a zinc rich primer.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
      a. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inch x 8 inches long.

2.06 SHELF AND RELIEVING ANGLES

A. Fabricate shelf and relieving angles from steel angles of sizes indicated and for attachment to concrete framing. Provide slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches o.c., unless otherwise indicated.

B. Galvanize shelf angles to be installed on exterior concrete framing.

2.07 FINISHES, GENERAL

A. Comply with NAAMM “Metal Finishes Manual” for recommendations relative to application and designations of finishes.

B. Finish metal fabrications after assembly.

C. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:
   1. ASTM A153 for galvanizing iron and steel hardware.
   2. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.

D. Preparation for Shop Priming: Prepare un-coated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Interiors (SSPC Zone 1A): SSPC-SP3 “Power Tool Cleaning”:

2. Apply shop primer to un-coated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
3. Lead free, alkyd primer: Manufacturer's standard.

2.08 ACCESS DOORS

A. Manufacturer: Milcor Limited Partnership, 1150 North Cable Road, Lima, OH 45805, 1-800-528-1411, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.02 CLEANING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 05 50 00

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Includes: Provide rough carpentry, and installation of items specified in other Sections, normally installed by carpenters. Section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Shop Drawings: 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 locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

D. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 QUALITY ASSURANCE

A. Material Grading: Identify hardboard, particleboard, lumber, and plywood by affixing grademark, stamp, or related identifying marks indicating material grades, rules or standards under which they are produced, and complying with rule or standard under which the material is produced. Use certified inspection agency certified by the Board of Review, American Lumber Standards Committee, to grade lumber species. In lieu of piece grade-marking, a certificate of inspection from an agency certified by the Board of Review, American Lumber Standards Committee may be furnished for precut lumber. Applicable grading rules are as follows:
   1. Douglas Fir, White Fir, and Cedar: "Standard Grading and Dressing Rules for West Coast Lumber" as published by the West Coast Lumber Inspection Bureau.
   2. Ponderosa and Western White Pine: "Grading Rules for Western Lumber", published by the Western Wood Products Association.
   3. Southern Yellow Pine: "Standard Grading Rules for Southern Pine Lumber" as published by the Southern Pine Inspection Bureau.
   4. Redwood: "Standard Specifications for Grades of California Redwood Lumber" as published by Redwood Inspection Service.

B. Plywood: Conform to U. S. Product Standard PS 1 issued by the National Bureau of Standards. Stamp or brand each standard size panel to show type and grade of panel. When used structurally, plywood to meet performance standards for its type as described in Product Standard PS 1 for Douglas Fir plywood. Furnish material identified as to species, grade, and glue type by an approved agency or independent testing laboratory with appropriate affixed grade-marks on each panel. Provide in addition to above requirements, exterior type plywood for permanently exposed plywood in outdoor applications.

C. Qualifications of Workmen: Provide sufficient skilled workmen and carpenter foreman present at all times during execution of this portion of the Work, thoroughly familiar with type construction involved, materials and techniques specified.

1.05 PRODUCT HANDLING

A. Protection:
   1. Store materials to ensure proper ventilation and drainage. Protect against damage and weather.
   2. Deliver materials to job site and store, in safe area, out of the way of traffic, and shored off ground surface.
   3. Identify framing lumber as to grades and store grades separately.
   4. Protect metal products with adequate weatherproof outer wrappings.
   5. Use extreme care in off-loading lumber to prevent damage, splitting, and breaking materials.

B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect at Contractor's expense.

PART 2 - PRODUCTS

2.01 LUMBER

A. Provide lumber for structural carpentry using following species provided grade for each is not lower than minimum shown:

1.	Pine, Southern Yellow - SPIB Rules (KD)	No. 2 Common
2.	Fir, Douglas - WCLIB Rules	Standard
3.	Fir, White - WCLIB Rules	Standard
4.	Pine, Western White - WWPA Rules	Standard
5.	Redwood - RIS Rules	Construction Heart
6.	Cedar, Western Red, & Incense - WCLIB Rules	Standard

B. Lumber (except where otherwise noted): Surfaced 4 sides unless, in addition to being dressed, it has been notched, ship-lapped, or patterned.

C. Lumber Dimensions: Are nominal.

D. Structural Performance: Metal-plate-connected wood trusses shall be 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:
      a. Roof Trusses: Vertical deflection of 1/360 of span.

E. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

F. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 FIRE-RETARDANT AND PRESERVATIVE TREATED LUMBER

A. Manufacturers: Provide wood treatment by or under license from Chemical Specialties, Inc., One Woodlawn Green, Suite 250, 200 E. Woodlawn Road, Charlotte, NC 28217. ASD. Tel: (800) 421-8661, or approved equal by one of the following companies:
   1. Osmose, Inc., 1016 Everee Ln., Griffin, GA 30224
   2. Arch Wood Protection, Inc., 1955 Lake Park Dr., Ste. 250, Smyrna, GA 30080
   3. Hoover Treated Wood Products, Inc., 154 Wire Rd., Thomson, GA 3082

B. Fasteners and Connectors: For treated wood and where wood is in ground contact, subject to high relative humidity, or exposed to weather, provide steel fasteners with hot-dip galvanized coating per ASTM A153/A153M; provide steel connectors with hot-dip galvanized coating per ASTM A653, Class G185 sheet with 1.85 ounces of zinc coating per square foot.

C. Wood Preservative Treatment:

1. ACQ Preserve.
    a. Use 0.25 lb/cu ft (4.0 kg/cu m) retention.
    b. Kiln dry after treatment to 19 percent maximum moisture content for lumber and 18 percent for plywood.
    c. Treat wood in the following locations:
        1) In contact with roofing, flashing, or waterproofing.
        2) In contact with masonry or concrete.
        3) Within 18 inches (450 mm) of grade.
        4) Exposed to weather.
        5) Other locations indicated.

D. Fire-Retardant Treatment:
1. Lumber: Comply with AWPA C20 .
2. Plywood: Comply with AWPA C2 7, Type A.
3. Surface Burning Characteristics: UL FRS rating; flame spread and smoke developed ratings of 25 or less in a test of 30 minutes' duration.
4. Treatment: D-Blaze®.

2.03 PLYWOOD

A. Plywood (not otherwise specified or noted on the Drawings): Douglas Fir or Southern Yellow Pine panels, C-D grade for concealed applications and A-C grade for exposed applications, meeting U.S. Product Standard PS 1.

B. Wall Sheathing:
1. Minimum 11/32 inch thick with supports 16 inches on center and 15/32 inch thick with supports 24 inches on center unless specified otherwise.
2. Minimum 48 inches wide at corners without corner bracing of framing.

C. Roof Sheathing:
1. Minimum 19/32 inch thick or span rating of 40/20 or 23/32 inch thick or span rating of 48/24 for supports 24 inches on center.

C. Radiant Barrier Roof Sheathing:
1. Minimum 15/32 inch thick or span rating of 32/16 or 19/32 inch thick or span rating of 40/20 for supports 24 inches on center as manufactured by:
    a. LP® TechShield® Radiant Barrier.
    b. Weyerhaeuser Radiant Barrier Sheathing (RBS) Roof Panels .
    c. Georgia-Pacific Thermostat® Radiant Barrier Sheathing.

D. The backs of parapet walls are required to be sheathed with Exterior Grade plywood.

2.04 HARDWARE

A. Provide rough hardware required for proper installation of carpentry work. Furnish hot-dipped galvanized, nails, spikes, screws, bolts, ply clips and similar items using proper types and ample sizes to fasten and hold the various members securely in place.

B. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.

C. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

2.05 METAL CONNECTOR PLATES

A. Fabricate connector plates to comply with TPI 1.

B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; 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 coating designation; and not less than 0.036 inch thick.
   1. Use for interior locations unless otherwise indicated.

C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
   1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316, and not less than 0.035 inch thick.
   1. Use for exterior locations **[, wood-preservative-treated lumber,] [fire-retardant treated lumber,]** and where indicated.

2.06 MANUFACTURED ENGINEERED WOOD

A. Provide Glue Laminated construction framing, Microllam or Laminated Veneer Lumber (LVL), Laminated Strand Lumber (LSL), Parallam or Parallel Strand Lumber (PSL), Oriented Strand Lumber (OSL), Rim Boards, Prefabricated Wood I-Joists and related accessories as indicated on the drawings.

2.07 BLOCKING

A. Provide solid wood blocking system capable of sustaining loads as listed within these documents, including drawings. Do not cut or bend metal studs, or cut wood studs, to achieve flush fit to face of studs. Blocking is to span between vertical studs and be fire resistant where applicable. Verify with architect any condition or loading requirement not listed. 2x solid blocking or two layers of 5/8" or 3/4" plywood, depending on required loads and clearances, may be used at contractor option. Coordinate any electrical and audio visual components, including back-boxes and conduit, with respective contractors.
   1. Attach blocking between studs for support of surface mounted items.
      a. Plumbing fixtures.
      b. Toilet partitions.
      c. Wall cabinets.
      d. Toilet accessories

e. Hardware.
f. Architectural woodwork.
g. Grab bars.
h. Handrails and railings.
i. Signage.
j. Other items requiring backing for attachment.

2.08 OTHER MATERIALS

A. Provide materials, not specifically described but required for a complete and proper installation using new material, suitable for the intended use, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. Carpentry: Produce joints true, tight, and well nailed. Lay out, install and fit wood framing, furring, stripping, and blocking as required by conditions encountered.

B. All Work: Plumb, level, and brace with sufficient nails, spikes, and bolts required to ensure secure attachment and rigidity.

C. Any piece of work or carpentry material with defects that prevent it from serving its intended purpose satisfactorily, including crooked, warped, bowed, or otherwise defective material, even if within the limits of grade specified, will be rejected. Replace with an acceptable piece.

3.02 TEMPORARY ENCLOSURES AND PROTECTION

A. Provide temporary enclosures at door, window, and related openings in exterior walls, as necessitated by weather and adverse conditions. Maintain enclosures in good repair and remove when no longer needed. Protect door and window frames.

3.03 STUD WALLS AND PARTITIONS

A. Sole Plates: Single 2" thick members for walls and partitions.

B. Studs (unless otherwise called for): 2 x 4's spaced 16" maximum o.c., doubled at sides and heads of openings, tripled at corners and placed to provide end nailing for sheathing. Toenail studs to sole plates with two 8d nails on each face side of each stud. Lay out studs so one occurs at each joint in plywood paneling and gypsum board.

C. Top Plates: Double 2" thick members for walls and partitions.

D. Provide plates of same width as studs to form continuous horizontal ties. Provide suitable splice plates at ends of sole plates, securely nailed in place. Nail lower members of top plates to studs and corner posts with two 16d nails at each stud and post. Nail upper and lower members of top plates together with 10d nails spaced 16" o.c.. Use two 10d nails at ends of upper members, and arranged so no joint in an upper member occurs over joint in lower member. Provide trusses and lintels over openings in walls and bearing partitions. Splices in plates not permitted over openings where a plate forms part of lintel.

E. Provide one row of horizontal blocking between studs, near mid-height of wall. Furnish blocking of same width as studs.

F. Provide additional blocking for anchorage of wall or ceiling mounted items as follows:
   1. Attach blocking between studs for support of surface mounted items.
      a. Plumbing fixtures.
      b. Toilet partitions.
      c. Wall cabinets.
      d. Toilet accessories
      e. Hardware.
      f. Architectural woodwork.
      g. Grab bars.
      h. Handrails and railings.
      i. Signage.
      j. Other items requiring backing for attachment.
      k. DO NOT impede attic ventilation over the entire roof area.

G. Anchor plates and sills of interior partitions to concrete slab with "Ramset", or approved equal, power-driven drive pins. Use No. 3330 drive pins. Set drive pins not less than 2" from edge of concrete. Spacing of drive pins not to exceed 4 feet on centers with drive pins at ends of all sections of plate.

3.04 ROOF FRAMING

A. Use roof anchors to anchor roof trusses to top plates. Provide anchors using approved design and made of 18 gauge zinc coated metal. Fasten each anchor in place with nails made especially for that purpose by anchor manufacturer, using one nail at each nail-hold provided. Use one anchor at each end of truss involved.

B. Roof Trusses:
   1. Provide "plate" type trusses constructed with precut and carefully fitted members assembled to ensure uniformity. Construct trusses true to line and dimensions, within 1/4" tolerance for length and 1/8" for height.
   2. Design trusses to meet design requirement set forth on the Roof and Roof Framing Plan requirements. Base computations on net sizes of American Lumber Standards for dressed lumber corresponding to the given nominal sizes which are the minimum permissible. Select each piece for suitability and cut to avoid large and unsound knots at connections.

3. Provide joint connections and interior bracing for roof trusses as required for approved, engineering designed truss systems by MiTek Industries; Alpine, a Division of ITW Company; Eagle Metal Products or approved equal.
4. Wood truss fabricator shall submit calculations and shop drawings sealed and signed by a professional engineer registered in the State of Arkansas to the architect for review prior to fabrication.
5. Erect trusses in position, perpendicular to wall plates. Straighten by nailing temporary spacers to top and bottom chords before application of roof sheathing.
6. Contractor shall provide bracing for truss chords and web members as required by the truss fabricator. System is not stable until sheathing and permanent bracing are installed.
7. All lumber used for wood trusses shall be #2 Grade, Kiln Dried Southern Pine; #2 Grade, Kiln Dried Spruce-Pine-Fir; or #2 Grade Hem-Fir or better, UON.
8. Minimum truss plate size shall be 3" x 5" or 4" x 4" each side of truss at all joints.
9. Minimum contact areas for truss plates shall be 3.75 square inches on each member at all joints, each side of truss.

3.05 PLYWOOD INSTALLATION

A. Roof Sheathing: Apply with surface grain at right angles to supports. Support end joints of sheets on bearings and stagger with alternate courses in line. Provide edge blocking or suitable edge support. Fasten plywood in place with 8d nails spaced 6" o.c. at edge and end supports and 12" o.c. at intermediate supports. Provide hold-down clips as required.

B. Wall Sheathing: Apply with surface grain parallel to supports. Support end joints of sheets on bearings and stagger with alternate courses in line. Provide edge blocking or suitable edge support. Fasten shear panels in place with 10d common nail at 6" o.c. at edge and end supports and 12" o.c. at intermediate supports. Fasten shear panels to cold-formed steel with #8 TEK screws at 6" o.c. at edges and end supports, and at 12" o.c. at intermediate supports.

C. Sub-flooring: Apply with face grain at right angles to supports with edges 1/8 inch apart at side joints and 1/16 inch apart at end joints, and nail at supported edges 6 inches on center and at intermediate supports 10" o.c.. Provide 1/4" clearance at walls. Install each panel with end joints occurring over supports and end joints staggered.

D. Underlayment: Apply with edges 1/32" apart at joints, nailed 6" o.c. at edges and 8" o.c. throughout remainder of panel. Nail at edges 3/8" from edges. Provide 1/4" clearance at walls. Do not locate underlayment joints directly over parallel joints of sub-flooring. Plywood combination sub-floor underlayment may be used in lieu of separate layers. If used, install as specified for plywood subfloor, except make all joints occur over supports unless tongued and grooved edges are used. Lightly sand any surface roughness at nail heads or joints to blend with the undisturbed surface.

END OF SECTION 06 10 00

PART 1 – GENERAL

1.1 APPLICATION

A. This Specification Section applies to both interior and exterior applications, as shown on Drawings.

1.2 SECTION INCLUDES

A. Round timber frame structural assemblies.

1.3 RELATED SECTIONS

A. Section 03 30 00 “Cast-In-Place Concrete” for concrete foundations.

B. Section 03 37 13 “Shotcrete for Themework” for concrete applications.

C. Section 03 37 20 “Artificial Themework” for photo references of required themework applications.

D. Section 06 10 00 “Rough Carpentry” for related framing systems.

1.4 REFERENCES

A. International Log Builders Association (ILBA): Log Span Tables for Floor Joists, Beams and Roof Support Systems.

B. US Department of Agriculture Forest Service: Wood Handbook - Wood as an Engineering Material.

C. Timber Construction Manual, Herzog, Natterer, Schweitzer, Bolz, Winter.

D. American Institute of Timber Construction: AITC 108 - Standard for Heavy Timber Construction.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide engineered round timber structural assemblies meeting or exceeding code-required design loads:
   1. For commercial and institutional construction, comply with manufacturer's structural engineering data.
   2. Deflection limits shall not exceed 1/360 for floor/ceiling systems with wallboard finishes and 1/240 for roof systems with wood ceiling finishes.

B. Delegated Design: Provide structural engineering shop drawings for timber construction, prepared by a professional engineer licensed in the jurisdiction of the Project site and engaged by the supplier of timbers.

C. Fire Rating: Decorative unmilled timber is a combustible material. Fire retardants can be applied when necessary in Types 1 and 2 construction. Follow ASTM fire rating standards to assess the rating of untreated timbers. Non-structural timbers of 5 inches or greater may qualify for a 1-hour or greater fire rating. Always communicate fire rating requirements to round timber manufacturer.

1.6 SUBMITTALS

A. Submit under provisions of Section 01 33 00 “Submittal and Substitution Procedures.”

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Provide detailed shop drawings including materials, connections and relationship with adjacent construction. Include small diameter timber, columns, branched columns and real whole trees with engineered connection points using wood and steel connectors and fasteners. Shop drawings shall be stamped by a professional engineer licensed in the jurisdiction of the Project.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 8 years’ experience in timber frame construction.

B. Contractor’s Qualifications: Minimum 5 years’ experience in timber frame construction.

C. Installer Qualifications: Minimum 2 years’ experience installing similar products and acceptable to the manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in accordance with manufacturer's recommendations. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Handle materials to avoid damage.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.10 PRE-INSTALLATION MEETINGS

A. Convene minimum 2 weeks prior to starting work of this Section. Agenda shall include sequence of construction, work of related trades, protection of materials and similar items.

1.11 SMALL DIAMETER (4" to 24") ROUND TIMBER CONSTRUCTION

A. Round Timber Structure Contractor shall have experience in design, shop fabrication and installation of small diameter round timber construction with straight columns, y-branch columns and real whole trees with engineered connection points using steel connectors and fasteners. Provide PE-stamped shop drawings based on International Log Builders Association Span Table Guidelines, NDS guidelines and design values database derived from destructive testing at the United States Department of Agriculture Forest Products Lab in Madison, WI.

B. Round timber installation shall be coordinated and resemble real tree applications as shown on Drawings and required in the "Artificial Themework" Specification Section.

1.12 CONTRACTOR QUALIFICATIONS

A. Round Timber Structure Contractor shall have experience building with small diameter round timber (4 to 24 inches) for more than 5 years and experience prefabricating engineered connection points with steel connectors and fasteners for more than 5 years. Round Timber Structure Contractor shall have a minimum of 10 small diameter round timber agricultural and/or commercial structures completed. Provide list available as requested.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: WholeTrees® Structures, which is located at 800 Williamson Street, Madison, WI 53703; Tel: 608-310-5282; Email: info@wholetrees.com; Web: www.wholetrees.com

B. Manufacturer shall be a WBE or B Corp.

C. Requests for substitutions will not be considered.

2.2 MATERIALS

A. Columns: Factory fabricated with engineered connection points using either wood and steel connectors or fasteners.
   1. Column diameters within manufacturer's standard limits, typically 4 inches to 24 inches.
   2. Column lengths within manufacturer's standard limits, typically 7 feet to 40 feet.
   3. Treated with 1 coating of Timbor or another approved insecticide/fungicide.
   4. Finish: One coat of Natural Coat clear finish or approved alternative.
   5. Species as selected by Architect and acceptable to manufacturer.

B. Branched Columns: Factory fabricated with engineered connection points using wood or steel connectors or fasteners.
   1. Column diameters within manufacturer's standard limits, typically 4 inches to 24 inches.
   2. Column lengths within manufacturer's standard limits, typically 7 feet to 40 feet.

3. Treated with 1 coating of Timbor or another approved insecticide/fungicide.
4. Finish: One coat of Natural Coat clear finish or approved alternative.
5. Species as selected by Architect and acceptable to manufacturer.

C. Connectors and Fasteners: Interior grade or exterior grade finishes and steel per service and engineering requirements.

D. All structural round timber to be third-party graded.

2.3 FABRICATION

A. Inspect columns, branched columns and real tree members with regard to ability to select stand, visual, and digital timber grading as applicable, and post peeling inspection process.

B. Factory fabricate timbers to the greatest extent practical, including pre-drilling.

C. Fabricate and disassemble engineered wood structures, columns, and trees, and ship structural system connections to jobsite.

2.4 TIMBER SELECTION

A. Round Timber Structure Contractor shall source timber from suitable stands. All external columns shall be Black Locust or White Oak. Interior columns shall be mixed hardwoods and beams, softwoods. Relevant Code Information: IBC 2006; Designation: 2304.10 Heavy Timber Construction.

B. Round Timber members shall be peeled and seasoned or kiln dried to 19 percent or lower moisture level at 3-inch depth. Sanded smooth to 80 grit. Treated with 1 coating of Timbor or another approved insecticide. Treated with 1 coating of Heritage Natural finish or approved alternative.

C. Round Timber members shall pass a 3-step grading process including third-party grading or ASTM-derived design values (ASTM D2555, D2899, D3200, D3957) – ability to select stand, visual, or non-destructive evaluation timber grading, and post peeling inspection process. Shop fabrication of small diameter round timber shall be to the greatest extent practical, including pre-drilling, fastening, connectors and joinery. Y-branching connections shall be prefabricated with engineered connection points using steel connectors or fasteners. The structural system shall have connection points shop fabricated, disassembled, staged and shipped to jobsite. Connectors and fasteners shall be rated exterior grade.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. If substrate preparation is improper, notify Architect before proceeding.

3.2 PROTECTION

A. Protect installed products from construction activities until completion of Project to ensure no damage occurs in construction.

B. Touch up, repair minor nicks, dings and gouges to timber members before Substantial Completion. Replace damaged members as directed where damage is beyond satisfactory repair.

C. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations and with approved shop drawings. Installation shall be performed by the manufacturer or an installer acceptable to the manufacturer.

B. Time delivery and installation of timber to avoid extended on-site storage and to avoid delaying work of other trades that follow.

C. Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements on the provided shop drawings.

D. Do not cut members without first receiving approval from the manufacturer. Where field fitting is required, consult and comply with manufacturer's recommendations.

E. Touch up, repair or replace minor damage to timber members before Substantial Completion. Replace damaged members as directed where damage is beyond satisfactory repair.

F. Install in accordance with approved shop drawings and in proper relationship with adjacent Construction.

G. Do not begin installation until substrates have been properly prepared per the shop drawings. If substrate perpetration is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

H. Prepare surfaces using methods recommended by the manufacturer (including sanding and finishes, etc.).

I. Installation of members in accordance with the details and notes on the approved Construction Documents and shop drawings.

J. Erect framing true and plumb and in proper relationship with adjacent construction.

END OF SECTION 06 13 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install wood finish trim, wood doors and frames, finish hardware, and related finish carpentry items specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A208.1 - Particleboard, Mat-Formed Wood.
   2. ANSI A208.2 - Medium Density Fiberboard for Interior Use.

B. ASTM International (ASTM):
   1. ASTM D 1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
   2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Architectural Woodwork Institute (AWI):
   1. AWI Quality Standards; Sections 100, 200, 400, 500, 600, 700, 1500, and 1700.

D. Composite Panel Association (CPA):
   1. CPA-4-19 - Eco-Certified Composite (ECC) Sustainability Standard.

1.05 QUALITY ASSURANCE

A. Qualifications of Workmen: For actual cutting and fitting of trim and finish material, use journeyman finish carpenters thoroughly trained and experienced in skills required, completely familiar with materials involved and manufacturers' recommended methods of installation, and thoroughly familiar with requirements of this work.

B. Material Grading: Furnish hardboard, lumber, and plywood bearing grademark, stamp, or related identifying marks indicating grades of material and rules or standards under which they are produced. Provide identifying marks on a material to comply with rule or standard under which material is produced. Retain inspection agency for lumber certified by the Board of Review, American Lumber Standards Committee, to grade species used. For moldings apply association grademark to each bundle in bundled stock. In lieu of piece grademarking, a certificate of inspection from an agency certified by the Board of Review, American Lumber Standards Committee may be furnished for pre-cut lumber.

C. Furnish wood trim meeting or exceeding the Quality Standards of the Architectural Woodwork Institute for "Custom Grade".

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship for each type MDF paneling and MDF sanding and running trim using manufacturer approved installation methods.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship and appearance are approved by Architect.
   3. Subject to approval by Architect, mock-up may be retained as part of finish work.

1.06 PRODUCT HANDLING

A. Protection: Protect materials of this Section before, during, and after installation. Protect installed work and materials of other trades.
B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

2.01 LUMBER NOT OTHERWISE SHOWN

A. Provide kiln dried lumber for trim with 8% to 12% moisture content range.

B. Where not specifically otherwise called for, provide lumber for finish carpentry using "C and Better" grade, Southern Yellow Pine, kiln dried to 12% maximum moisture content.

2.02 CYPRESS LUMBER

A. Cypress Lumber: Tidewater Red Cypress, No. 1 Common (SCMA Rules).

2.03 PLYWOOD NOT OTHERWISE SHOWN

A. Provide hardwood surface veneer plywood core material.

B. Plywood (not otherwise noted): Paint grade Birch with all visible sides, equal to INT-APA quality plywood.

PART 3 - EXECUTION

3.01 TRIM AND FINISH

A. Provide trim and finish using smooth material, properly membered or mitered, set true, level and plumb, with tight joints and securely fastened in place. Furnish lengths of lumber without joints on a straight run where possible. Where joints are necessary, make on 45° angle against the light, accurately and neatly. Provide moldings true to details, cleanly cut and sharp. Sand exposed surfaces to an even, smooth surface, ready for finish. Join mill assemblies with concealed nails or screws, mortise and tenons, dowels or glued blocks. Neatly cope intersection molds. Back out or saw kerf flat members of wood trim to prevent warping. Protect finish from dampness at all times until painted or varnished. See paragraph below regarding backpriming before installation. Protect finish so completed results will show as little of the joints as possible and no tool marks, machine marks, nail holes, and nails.

3.02 BACKPRIMING

A. Back prime trim. Perform by subcontractor for painting work. Notify subcontractors that trim is ready for back priming in ample time to permit application and drying of required paint before installation of trim is scheduled to start.

3.03 HARDWARE

A. Install rough hardware including but not necessarily limited to nails, screws, anchor bolts, and wall plugs, in types, sizes, and quantities required for secure anchorage of carpentry work.

3.04 FINISHING

A. Sandpaper finish wood surfaces thoroughly to produce a uniformly smooth surface, always sanding in direction of the grain. Do not sand wood which is designed to be left rough. No coarse grained sandpaper marks, hammer marks, and related imperfections will be accepted.

END OF SECTION 06 20 23

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install insulation and related items specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 PRODUCT HANDLING

A. Protection:
   1. Deliver materials to job site and store in safe dry place with labels intact and legible at time of installation.
   2. Protect building insulation materials before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

1.05 REFERENCES

A. Concealed Installations: Flame Spread rating of not more than 75 and a smoke developed rating of not more than 450 when tested in accordance with ASTM E84.

B. Exposed Installations: Flame Spread rating of not more than 25 and a smoke developed rating of not more than 450 when tested in accordance with ASTM E84.

PART 2 - PRODUCTS

2.01 RIGID PERIMETER INSULATION BOARD

A. Where indicated as "Perimeter Insulation" at turn-down slab transitions, provide 2" thick Stryrofoam™ Brand Square Edge Extruded Polystyrene (XPS) Foam Insulation Shiplap, Owens Corning® FOAMULAR® 250, or approved equal. Insulation Minimum R-Value is to meet ASHRAE 90.1-2022 for heated Slab-On-Grade Floors of R-15 for 24 inches.
   1. Sopra-XPS by Soprema.US, 800-356-3521.
   2. Dupont™ Styrofoam™ Brand Cavitymate™ Ultra Extruded Polystyrene Insulation.
   3. Kingspan GreenGuard® Type IV XPS Insulation Board.

B. Installation is to be per manufacturer's published recommendations.

2.02 BATT INSULATION

A. Fiberglass Building Insulation Manufacturers:
   1. Certainteed, 800-233-8990
   2. Johns Manville, 800-866-3234
   3. Knauf Insulation, 800-825-4434
   4. Owens Corning Fiberglass, 800-GET-PINK

B. Material: Formaldehyde-free Fiberglass type bearing the UL Classification marking as to fire resistance conforming to Federal Specification HH-I-521F, and ASTM C-665:
   1. Un-faced, Type I in walls and above ceilings or at bottom chord of trusses.

2.03 OTHER MATERIALS

A. Provide materials including fasteners and retainers, not specifically described but required for complete and proper installation of building insulation, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection: Carefully inspect installed work of other trades and verify that work is complete to point where this installation may properly commence.

B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 INSTALLING BATT AND BLANKET INSULATION

A. Install vapor barriers flat against framing members, without buckles or wrinkles and secure in place to avoid leakage in air borne water vapor.

B. After piping and wiring is in place, install and support blanket and batt insulation in position required, and coordinate with framing, including wood trusses.

1. Secure un-faced batt insulation at bottom of roof deck between wood rafters/trusses with netting mesh appropriately suspended to allow full depth of prescribed R-Value. Overlap upper and lower netting seams 2-3 inches. Insure that netting remains taut. Refer to manufacturer's published recommendations.
   a. Provide Medium Duty 1/4" Mesh as supplied by ADO Products, 13220 Wilfred Lane North, Suite 100, Rogers, MN 55374 or approved equal. Tel.: (800) 666-8191.

C. Remove insulation and vapor barriers torn, displaced, water soaked, and damaged. Replace with new material.

3.03 INSTALLING OTHER INSULATION

A. Install materials not specifically set forth above in strict accordance with manufacturer's instructions.

END OF SECTION 07 21 00

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install Injection Foam Insulation and related items in core-cells of Concrete Masonry Unit (CMU) walls.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCED STANDARDS

A. ASTM E-84 "Standard Test Method for Surface Burning Characteristics of Building Materials."

B. ASTM C-518 "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."

C. NFPA 259 "Standard Test Method for Potential Heat of Building Materials"

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A firm with experience installing insulation systems of the type specified and authorized by the foam manufacturer.

B. Fire Resistance Characteristics: As determined by testing identical products according to NFPA 285 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery
   1. Materials shall be delivered to installer in manufacturer's original, unopened, undamaged containers with identification labels intact.
   2. Installer will blend resin and foaming catalyst according to the manufacturer's instructions prior to arriving at the jobsite and/or at the jobsite, at the installer's discretion.

B. Storage and Handling
   1. Materials should be stored in original paper packages and boxes protected from moisture until used by installer.
   2. Once blended with water by installer, materials must be maintained at a minimum temperature of 75° F.

1.07 PROJECT/SITE CONDITIONS

A. The wall assembly must be essentially dry with no standing water in the CMU core cells and no visible wetness on exterior surfaces.

B. Mortar must be adequately cured prior to installation of foam insulation.

1.08 WARRANTY

A. Refer to manufacturer's standard warranty terms (as applicable).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: cfiFOAM, Inc., PO Box 10393, Knoxville, TN 37939. Telephone: 800-656-3626. Fax: 865-588-6607. Website: www.cfifoam.com

B. Approved equal:
   1. Natural State RetroFoam™, 500 Amity Rd, Ste 5B, Conway, AR 72032. Tel.: (501) 697-9752. https://naturalstateretrofoam.mydex.com

2.02 MATERIALS

A. Masonry Foam Insulation (Foamed-in-Place)
   1. Description: Cellular plastic insulation comprised of a spray-dried polymeric resin and a foaming catalyst concentrate that are combined with water for injection, along with compressed air, into the wall cavity by an authorized installer.
   2. Surface Burning Characteristics - ASTM E84: Class A or Class I
      a. Flame Spread: 25 or Less
      b. Smoke Generated: Less than 450

c. Thickness: 3.5 inches (maximum thickness per test apparatus).
d. Tests performed by an independent, accredited laboratory located within the USA.

3. Thermal Performance (foam) - ASTM C177 or ASTM C518:
   a. k-Value: k-0.23/inch @ 75°F mean temperature.
   b. R-Value: R-4.60/inch @ 75°F mean temperature.
4. Potential Heat - NFPA 259
   a. Potential Heat ≤ 8000 Btu/lb.
5. Dimensional Stability (Shrinkage)
   a. ≤ 0.5% - 12 x 8 x 16 CMU Enclosed Core Cell
6. Density of Foam:
   a. Wet Foam 12" x 12" x 12" box weight: 2-½ to 3-¼ lbs.
   b. Cured Foam: 0.5-1.0 lbs./ft3

PART 3 - EXECUTION

3.01 GENERAL

A. Comply with the instructions and recommendations of the foam-in-place insulation manufacturer.

3.02 EXAMINATION

A. Site Verification
   1. Verify that the wall assembly is essentially dry.
   2. Verify that no water is standing in core cells within the wall assembly.
   3. Verify that mortar is adequately cured.

3.03 PREPARATION

A. Select the best location(s) to inject foam:
   1. Preferably through wall surfaces to be covered.
   2. 5/8"-7/8" holes to be drilled in masonry joints or directly through CMU face walls

3.04 INSTALLATION GUIDELINES

A. All empty core cells and voids within each insulated wall shall be filled with foam insulation as shown on the drawings.

B. Walls can be filled using either top-fill or by pressure-injection techniques.
   1. For top-fill, the installer must use an extension tube to begin installing foam from the bottom of the cavity, withdrawing the extension tube as foam fills the cavity.

2. For pressure-injection, holes are drilled in each CMU-3/8" holes for visually sensitive areas for use with a low-volume touch-up gun, 5/8" holes for use with a standard foam gun, or 7/8" holes for use with a high-volume production gun-at an approximate height of four feet from finished floor level. Normally each vertical cell column is drilled and injected with foam in 10'-24' lifts.
3. Masonry Foam Insulation is injected until it completely fills each vertical cell column, as evidenced by foam exiting adjacent injection holes. Repeat steps 1 and 2 at intervals of 10' to 14' above the initial row of injection holes, or as needed, until the wall is completely filled. Exit holes may be drilled beneath bond beams and at tops of walls to help visually verify complete foam filling.

C. After foam insulation sets, remove excess foam from outside of cavity, sweeping the wall and floor as needed. Cured foam is an inert material and, therefore, can be disposed of with other construction waste or worked into soils on-site in accordance with local regulations.

D. Patch holes with mortar to resemble adjacent surfaces.

3.05 FIELD QUALITY CONTROL

A. Testing
1. Verify insulation density by random sampling of foam
a. Fill a 12 x 12 x 12 box with foam
b. Foam weight should be 2 ½ - 3 ¼ lb.

B. Inspection
1. Verify complete filling of voids by drilling block face upon request.
2. Upon request by the Architect, Installer shall provide IR scans of all insulated masonry walls prepared and interpreted by IR technicians who are "BlockWallScanIR" trained and certified.
3. Correct all portions of the installation not in compliance with the Architect's requirements at no added cost to the Owner.

3.06 PROTECTION

A. Product should be protected from excess moisture during initial 24-hour curing period after installation. A 72-hour curing period is normally required prior to painting.

B. Foam should not be exposed to surfaces over 190°F for sustained periods of time.

END OF SECTION 07 21 19.13

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide vapor barrier and installation accessories for installation under concrete slabs.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Quality control/assurance:
   1. Summary of test results per paragraph 9.3 of ASTM E1745.
   2. Manufacturer's samples and literature.
   3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
   4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
   5. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.
   6. Vapor barrier manufacturer must warrant in writing (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
   7. Manufacturer’s verify in writing 20 years in the industry with no reported product failures.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E1745- 17 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
   2. ASTM E1643-18a: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
2. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Liner shall have all of the following qualities:
1. Maintain permeance of less than 0.01 Perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
2. Other performance criteria:
   a. Strength and Longevity: ASTM E1745.
   b. Thickness: 15 mils minimum
3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1.
4. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.

B. Vapor barrier product:
1. Basis of Design: Stego® Wrap Vapor Barrier (15-mil) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

C. Approved Alternate Manufacturers:
1. Griffolyn® Vaporguard® 15-mil manufactured by Reef Industries, 800-231-6074.
2. Moistop Ultra 15 by Fortifiber, (800) 773-4777. https://www.fortifiber.com/product/moistop-ultra-15/
3. **No Other Substitutions allowed.**

2.03 ACCESSORIES

A. Seams:
1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

B. Sealing Penetrations of Vapor barrier:
1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

C. Perimeter/terminated edge seal:
1. Stego Crete Claw (textured tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
2. Stego Term Bar by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
3. StegoTack Tape (double-sided sealant tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

4. One-sided seaming tape is not a recommended method of sealing at the terminated edge.

D. Penetration Prevention:
   1. Beast Foot by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

E. Vapor Barrier-Safe Hand Screed System
   1. Beast Screed by Stego Industries, LLC, (877) 464-7834 www.stegoindustries.com

PART 3 - EXECUTION

3.01 PREPARATION

A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
   1. Level and compact base material.

B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

3.02 INSTALLATION

A. Install vapor barrier in accordance ASTM E1643.
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
   2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
      a. Seal vapor barrier to the entire slab perimeter using manufacturer's textured tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
      b. Seal vapor barrier to the entire perimeter wall or footing/grade beam with manufacturer's double-sided tape, or both termination bar and double-sided tape, per manufacturer's instructions. Ensure the concrete is clean and dry prior to adhering tape.
   3. Overlap joints 6 inches and seal with manufacturer's seam tape.
   4. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
   5. Seal all penetrations (including pipes) per manufacturer's instructions.
   6. Avoid the use of stakes driven through vapor barrier by utilizing screed and forming systems that will not leave punctures in the vapor barrier.
   7. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

END OF SECTION 07 26 16

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Furnish all labor, material, tools, equipment and services required and in accord with provisions of Contract Documents.

B. Completely coordinate with work of all other trades.

C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Submit roofing manufacturer's inspection report after each of the three (3) required warranty inspections. Report must contain the following:
   1. A detailed description of all non-conforming work.
   2. Manufacturer's recommended method of correction.
   3. Color photographic documentation of non-conforming work.
   4. Color photographic documentation of subsequent accepted work.
   5. Drawings, Diagrams or Detail furnished by the inspector at the job site visit.
   6. Instructions and conditions for re-inspection and/or issuance of warranty.

1.04 QUALITY ASSURANCE

A. Applicable Standards:
   1. SMACNA: "Architectural Sheet Metal Manual", Sheet Metal and Air Conditioning Contractors National Association, Inc.
   2. LGSI: “Light Gage Structural Institute”
   3. AISC: "Steel Construction Manual", American Institute of Steel Construction.
   4. AISI: "Cold Form Steel Design Manual", American Iron and Steel Institute (1996 Edition).

5. UL580: " Tests for Uplift Resistance of Roof Assembles", Underwriters Laboratories, Inc.
6. FM: “Test Requirements for Class 1 panel roofs”, Factory Mutual Research Corporation.
7. UL2218: Class 4 Impact Resistance Rating
8. ASTM E 1592-95: "Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference", American Society for Testing and Materials.
9. ASTM E 1680: "Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems, American Society for Testing and Materials.
10. ASTM E 1646: "Standard Test Method for Water Penetration Through Exterior Metal Roof Panel Systems, American Society for Testing and Materials.
11. ASTM A 792-83-AZ50 (Painted) & ASTM A792-83-AZ55 (Bare Galvalume Plus®): "Specifications for Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process, General Requirements (Galvalume®)", American Society for Testing and Materials.
12. ASTM E 1514-98 (2017): "Standard Specification for Structural Standing Seam Steel Roof Panel Systems", American Society for Testing and Materials.
13. ASTM E 408-71: Standard Test Method for Total Normal Remittance of Surfaces Using Inspection- Meter Techniques. (Energy Star for Roof Products).
14. ASTM E 903-96 Standard Test Method for Solar Absorptions, Using Integrating Spheres. (Energy Star for Roof Products)
15. ANSI/SPRI/FM 4435/ES-1-11 “Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems”, and NRCA Guidelines for Complying With Building Codes Using ANSI/ SPRI ES-1. Provide shop drawings, to include wood blocking, to meet this standard or certified third party test data for gravel stop, fascia profiles and coping. Refer to the drawings for design wind load parameters. Include wind loads for roof area perimeters and corners on submittals.

B. Manufacturer's Qualifications:
1. Manufacturer has a minimum of five years experience in manufacturing metal roof systems of this nature. Panels specified in this section shall be produced in a factory environment (not with a portable roll former) with fixed-base roll forming equipment and in line leveling, assuring the highest level of quality control. A letter from the manufacturer certifying compliance will accompany the product material submittals.

C. Installation Contractor's Qualifications:
1. Installation contractor shall be an approved installer, certified by the manufacturer before the beginning of installation of the metal roof system.
2. Project foreman is the person having received certification by the manufacturer specific training in the proper installation of the selected metal roof system and will be present to supervise whenever material is being installed.
3. Provide certification letter that installation contractor has a minimum of three years' of metal product installation experience immediately preceding the date upon which work is to commence.

1.05 PRE-INSTALLATION CONFERENCE

A. Prior to installation of roofing system, conduct a pre-installation conference at the project site.

B. Attendance: Owner, Architect, Contractor, Project Superintendent, and Certified Installer.

C. Agenda:
   1. Roofing details and agenda
   2. Critical work sequencing and review of phasing plan
   3. Inspection sequencing

1.06 WARRANTY

A. Manufacturer Warranties:
   1. Panel Material: Furnish manufacturers 25 year warranty covering the panel against rupture, structural failure, or perforation.
   2. Panel Coating: Furnish manufacturer's 40-year warranty panel coating warranty covering cracking, checking, and peeling, and 30 year warranty covering fade and chalk.
   3. Metal Roof Weathertightness Warranty:
      a) Manufacturer's Single Source Weathertightness Warranty
         (1) Warranty term: 20 years commencing on date of substantial completion.
         (2) Total manufacturer's liability: NRL (No Repair Limit) / SF.
         (3) Warranty must cover: Pipe and Curb Penetrations; Wind Speeds up to 75 mph
            (a) Pipes must be centered in pan or a pipe curb must be used. Pipe must be flashed with an EPDM dektite.
            (b) Curbs must be all welded aluminum or stainless steel.
            (c) Manufacturer must supply engineered installation drawings signed and sealed by an engineer registered in the state in which the project is located.

B. Installer Warranty: Installer to provide warranty agreeing to repair or replace metal roof panels, trim, or accessories that fails due to poor workmanship or faulty installation.
   1. Warranty term: 2 years commencing on date of substantial completion.

1.07 PRODUCT HANDLING

A. Protection: Protect roofing materials before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide systems by MBCI or equivalent system by one of the following manufacturers:
   1. AEP Span
   2. Berridge
   3. Exceptional Metals
   4. McElroy Metal
   5. Metal Sales
   6. PAC-Clad
   7. Firestone UNA-CLAD™ UC-3

2.02 VERTICAL LEG STANDING SEAM METAL ROOF SYSTEM

A. Smooth MBCI "SuperLok", 2 inch high x 3/8” to 1/2” inch wide rib x 16" wide panel.

B. Metal Roof System Style: Vertical leg, concealed fastener, standing seam, utilizing male and female rib configurations, with factory applied hot-melt mastic in female rib, continuously locked together by an electrically powered mechanical seaming device during installation.

C. Gage: 24 gage

D. Substrate: ASTM A792, AZ50 Galvalume steel sheet, minimum yield of 50,000 PSI.

E. Clip: Two piece floating clip, 18 gauge base, 24 gauge top, with factory applied mastic.
   1. UL-90 rated - Underwriters Laboratories.

F. Finish: Finish to be Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation. Color to be selected by Architect from manufacturer's standard [complete] line.
   1. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.

G. Prefabricated Metal Roof Curbs:
   1. LMCurbs - Longview, TX, 1-800-284-1412.
      a. Curbs shall be constructed using minimum .080, 3003H14 aluminum, or heavier as required to support the load of equipment, with fully mitered and heli-arc welded corners, integral base plates, with water diverter cricket. Provide factory installed insulation.
      b. Minimum height of curb shall be 8" above roof (or as specified).
      c. Curbs shall be constructed to match slope of roof and provide a level top surface for mounting of equipment.
      d. Curb flange shall be constructed to match configuration of roof panel. Side flange shall extend to the next natural seam in the roof panels and conform to seam configurations.

H. Prefabricated Roof Jacks:
   1. SFS - iNTECH - Wyomissing, PA.
   2. ITW Buildex - Itasca, IL.

I. Rooftop Walkways:
   1. LM Curbs - Longview, TX.

J. Underlayment: 60 mil self-adhering ice and water shield membrane as manufactured by Mid-States Asphalt to be QUIK-Stick HT Pro High Temperature (textured film surface) or approved equal, designed for use in metal roof systems application.
   1. Elevate Self-Adhered CLAD-GUARD™ R Metal Underlayment

2.03 SNOW RETENTION SYSTEM

A. Snow Retention System:
   1. Provide 1" Sno Blockade™ Snow Retention System by Sno Gem, (1-888-766-4367) with the Sno Gem Sno Cube™ attachment bar system and "Blockade Plate™ for sliding snow and ice, spaced as recommended by manufacturer. Provide clamp style to coordinate with roof seam profile being proposed. Provide installation details to Architect for review prior to installation.
   2. Finish: Components to match the same paint finish color as the metal roof panels.
   3. Approved Equal Manufacturers:
      a. S-5! ColorGard by Metal Roof Innovations, Ltd., 888-825-3432.

2.04 MISCELLANEOUS MATERIALS

A. Fasteners:
   1. All self-tapping/self-drilling fasteners, bolts, nuts, self-locking rivets and other suitable fasteners shall be designed to withstand specified design loads.
   2. Use long life fasteners for all interior and exterior metal roof system applications.
   3. Provide fasteners with a factory applied coating in a color to match metal roof system application.
   4. Provide neoprene washers under heads of exposed fasteners.
   5. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

2.05 ACCESSORIES

A. Provide all components required per the metal roof system manufacturer's approved shop drawings for a complete metal roof system to include panels, panel clips, trim/flashing, fascias, ridge, closures, sealants, fillers and any other required items.
   1. All outside closures will be fabricated from Pre-Painted Galvalume sheet steel of the same gauge, finish and color as the panels.
   2. All tape seal is to be a pressure sensitive, 100 percent solids, polyisobutylene compound sealing tape with a release paper backing. Provide permanently elastic, non-sagging, non-toxic, non-staining tape seal approved by the metal roof system manufacturer.

3. All joint sealant is to be a one-part elastomeric polyurethane sealant approved by the metal roof system manufacturer.

2.06 FABRICATION

A. Material shall be in-line leveled prior to roll forming panel profile.

B. Where possible, roll form panels in continuous lengths, full length of detailed runs.

C. Standard panel length shall be no more than 50 feet long.

D. Fabricate trim/flashing and accessories to detailed profiles. If not detailed, submit standard profiles available for selection by Architect.

E. Fabricate trim/flashing from same material as panel.

2.07 PREFABRICATED CURBS AND EQUIPMENT SUPPORTS

A. Comply with loading and strength requirements as indicated where units support work of other trades. Coordinate dimensions of curbs and supports with equipment supplier/manufacturer.

B. Fabricate curbs of structural quality aluminum (Min. .080 in. thickness for mechanical gear up to 1000 lbs; .125 in. thickness for mechanical gear between 1000 lbs. and 2000 lbs.; use a two curb system per the manufacturer above 2000 lbs.), factory primed and prepared for painting with mitered and welded corner joints. Provide integral base plates and water diverter crickets. The upper flange of the curb must be a minimum of 18" above the water diverter. Curbs shall be designed to install under metal roof system on the high side and over metal roof system on the low side.

C. Minimum height of prefabricated curb will be 8 inches above the finished metal roof system.

D. Curbs shall be constructed to match the slope of the roof and provide a level top surface for mounting equipment.

E. Curb flanges must be constructed to match the configuration of the metal roof panels.

F. Curb manufacturer will provide their own curb structural support system that can be installed between the purlins that will allow proper thermal movement of the curb with the roofing system.

G. Submit roof curb manufacturer's shop drawings to metal roof system manufacturer for review prior to fabrication (refer to metal roof system manufacturer's standard installation details). Metal roof system manufacturer will review roof curb manufacturer's shop drawings for compatibility with metal roof system.

2.08 PREFABRICATED ROOF JACKS

A. Pipe flashings shall be a one piece EPDM (ethylene propylene diene monomer) molded rubber boot having a serviceable temperature range of -65°F to 212°F (for standard applications) or silicone molded rubber boot having a serviceable temperature range of -100°F to 437°F (for high temperature applications) and shall be resistant to ozone and ultraviolet rays. Units shall have an aluminum flanged base ring**. Do not install pipe flashings through any panel seams - install ONLY in the flat portion of the panel.**

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examination: Inspect installed work of other trades and verify that such work is complete to a point where this work may continue. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions. This specifically includes verifying that secondary structural members and/or decking are installed to meet UL and building code requirements. Coordinate with metal roof system manufacturer to insure that reduced clip spacings at eave, rake, ridge and corner areas are accommodated.

B. Discrepancies: In event of discrepancy, notify the architect. Do not proceed with installation until discrepancies have been resolved.

3.02 INSTALLATION

A. Install metal roof system so that it is weather-tight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.

B. Install metal roof system in accordance with manufacturer's instructions and shop drawings.

C. Provide concealed anchors at all panel attachment locations.

D. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.

3.03 ROOF CURB INSTALLATION

A. Comply with metal roof system manufacturer's shop drawings, instructions and recommendations for installation of roof curbs. Refer to metal roof system manufacturer's standard installation details. Anchor curbs securely in place with provisions for thermal and structural movement.

3.04 CLEANING, PROTECTION

A. Dispose of excess materials and remove debris from site.

B. Clean work in accordance with manufacturer's recommendations.

C. Protect work against damage until final acceptance. Replace or repair to the satisfaction of the architect (owner), any work that becomes damaged prior to final acceptance.

D. Touch up minor scratches and abrasions with touch up paint supplied by the metal roof system manufacturer.

E. Do not allow panels or trim to come in contact with dissimilar metals such as copper, lead or graphite. Water run-off from these materials is also prohibited. This specifically includes condensate from roof top A/C units.

1. Separate dissimilar metals from each other by painting each metal surface in area of contact with a bituminous coating, or by applying adhesive polyethlene underlayment to each metal surface, or by permanent separation as recommended by manufacturer.

END OF SECTION 07 41 13

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of metal panels is shown on the drawings and indicated by provisions of this section.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Installer must have experience with installation of metal panels of type and scope equivalent to work of this section.

B. Except as otherwise shown or specified, comply with applicable recommendations and details of "Architectural Sheet Metal Manual" by SMACNA. Conform to dimensions and profiles shown. Manufacturer to provide trained metal craftsmen to supervise installation.

C. Comply with ASTM E1592-94 - Structural performance of sheet metal siding by uniform static air pressure difference.

1.05 WARRANTY

A. Provide manufacturer's guarantee for exterior color finish for panels for a period of 25 years against blistering, peeling, cracking, flaking, checking, chipping and excessive color change and chalking. Color change not to exceed 5 NBS units (per ASTM D-2244.64T) and chalking not less than rating of 8 per ASTM D-659.

B. Panel Manufacturer: Furnish manufacturer's standard warranty to cover material for repairs to stop leaks resulting from natural deterioration of any component of the assembly including all flashing and trim installed as a part of the system. A specimen of the warranty shall be submitted for Architect's review prior to starting application. Warranty is to be in effect from Final Acceptance Date.

C. Furnish written guarantee signed by installer guaranteeing the installation of the panels to remain intact and free from leaks for two years following substantial completion date.

1.06 PRODUCT HANDLING

A. Protection: Protect materials before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide systems by PAC-Clad Petersen Aluminum Corp. or equivalent system by one of the following manufacturers:
   1. Atas
   2. Berridge
   3. Exceptional Metals
   4. MBCI (MasterLine 16)
   5. Metal Sales
   6. McElroy Metal
   7. Approved equal

2.02 WALL PANELS

A. Box Rib Profile: Precision Series HWP Concealed Fastener Metal Panels with rounded interlocking legs meeting ASTM E330. Provide 30-year non-prorated finish warranty.
   1. **Basis of Design:** PAC-CLAD Precision Series HWP Concealed Fastener Metal Panels
   2. Coverage Width: 16 inches
   3. Panel Attachment: Clip-fastened panel to accommodate thermal expansion and contraction.
   4. Height: 7/8 inch
   5. Nominal Coated Thickness: 24 gage.
   6. Panel Surface: Smooth
   7. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
   8. Exterior Finish: Fluoropolymer two-coat system.
   9. Color: As selected by Architect from manufacturer's standard stocked colors.

B. Furnish wall panels with side seams of interlocking type. Lap seams are not acceptable.

C. Fasten wall panels to supports with concealed clips, screws, or bolts to eliminate all exposed fasteners. Exposed screws, bolts, or rivets will not be allowed for securing trim, fascias, gutters, and miscellaneous flashing to wall panels. All fasteners will be concealed type.

D. Provide top, bottom, and intermediate panel closures, flashing, fascias, gutters, and trim using building manufacturer's standard components compatible with material furnished as wall panels.

E. Finish for wall panels to be Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect.
   1. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.

2.03 ENDLAPS

A. Pre-punch endlaps and provide an 18 gauge pre-punched backup plate and a 16 gauge pre-punched cinch strap for proper placement of fasteners.

B. Apply mastic between the panels and secure with self tapping fasteners through the cinch strap, panels and backup plate to form a compression joint.

2.04 FASTENERS

A. Provide manufacturer's recommended Lifetime self-drilling exposed fastening method.
   1. Panel Fasteners For panel to panel and panel to purlin connections to be No. 12-14 by 1 in. self-drilling, self tapping, hex head, plated steel screws with a 5/8 in. OD formed steel washer and a neoprene sealing washer.
      a. Alternate Fasteners - For panel to purlin connections, 1/4 - 14 HHAB self-tapping, plating steel screws, with a separate 5/8 in. OD dome shaped steel washer and a neoprene sealing washer may be used.
      b. No. 14-10HHA, self-tapping, plating steel screws, with a separate, 5/8 in. OD dome shaped steel washer and a neoprene sealing washer may be used.
   2. Spacing, for panel - to - purlin connections to be 12 in. on center beginning 2 - 1/2 in. from center line on one side of each major rib. Spacing at end lap to be in a 5 - 7 - 5 - 7 in. pattern beginning 2 - 1/2 in. from the center line on both sides of each major rib.
   3. Fastener for panel to purlin connection to be 1-1/4 in. long when insulation is greater that 4-1/2 in. Spacing for panel - to - panel connections to be 20 in. on center with a fastener located in line with the purlin fasteners

2.05 SEALANTS AND CLOSURES

A. Factory applied sidelap sealant is to be non-drying synthetic polymer based, designed for metal to metal concealed joints.

B. Field applied panel end sealant is to be extruded polymeric butyl tape.

C. Manufacture outside closures from same material as wall panel.

D. Manufacture inside closures from 18 gauge metal or neoprene.

2.06 FLASHING, TRIM AND ACCESSORIES

A. Flashing shall not compromise the integrity of the wall system by constricting movement due to thermal expansion and contraction.

B. Finish to be Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation to match wall panels.
   1. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.

C. Panel manufacturer to supply flexible membranes if applicable.

D. Manufacture all trim and flashing from Galvalume sheet steel.

E. All penetrations shall be flashed by panel installer and become a part of the panel manufacturer's weathertightness warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Seperate dissimilar metals from each other by painting each metal surface in area of contact with a bituminous coating, or by applying adhesive polyethylene underlayment to each metal surface, or by permanent separation as recommended by manufacturer.

B. Fabricate sheets, seams, strips, cleats, edge treatments, all integral flashing and other components to profiles, patterns and drainage arrangements shown or required. Provide for thermal expansion and contraction of the work. Seal joints as shown and as required for leakproof construction. Shop fabricate materials to greatest extent possible.

C. Joint Sealant: 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 is moderate at time of installation (40 deg. F to 70 deg. F), set joint members for 50% movement either direction. Adjust setting proportionately for installation at temperatures above 70 deg. F.

D. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks. Provide uniform, neat seams. Unless otherwise shown, fold back sheet metal to form a hem on concealed side of exposed edges.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

3.02 PROTECTION

A. Remove any protective film from exposed surfaces of metal panels with care to avoid damage to finish.

B. Provide final protection in a manner acceptable to installer that will insure metal panels being without damage or deterioration at time of substantial completion.

END OF SECTION 07 42 13

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PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish factory-primed fiber cement lap siding, panels, trim, fascia, molding, accessories and equipment for complete installation, to include field painting.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.

B. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY STORAGE & HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 WARRANTY

A. Product Warranty: Limited, non-pro-rated product warranty, for the following where applicable.
1. HardiePlank lap siding for 30 years.
2. HardiPanel vertical siding for 30 years.
3. HardieSoffit panels for 30 years.
4. HardieShingle siding for 30 years.
5. HardieTrim boards for 15 years.

B. Finish Warranty: Limited product warranty against manufacturing finish defects.

C. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free: 866-274-3464.
1. Approved Equal: Allura of Plycem, 15055 Woodham Drive, Houston, TX 77073, 844-425-5872 email: info@elementia.com www.alluraUSA.com
2. Nichiha Fiber Cement, 6465 E Johns Crossing, Ste 250, Johns Creek, GA 30097, 866-424-4421, www.nichiha.com
3. Louisiana-Pacific Corporation, 414 Union St, Ste 2000, Nashville, TN 37219, 888-820-0325, www.lpcorp.com

2.02 SIDING, SOFFIT AND TRIM

A. Provide the following products from James Hardie, or approved equal.
1. Hardie-Panel, vertical siding. Smooth.
2. Hardie-Soffit, panels (also see Beaded Porch Panel 4' x 8').
3. Hardie-Trim XLD, boards.

E. Soffit Panels: HardieSoffit soffit panel, factory sealed on 5 sides.
1. Type: Smooth non-vented, 12 inches by 12 feet
2. Type: Smooth non-vented, 16 inches by 12 feet
3. Type: Smooth non-vented, 24 inches by 8 feet
4. Type: Smooth vented, provides 5 square inches of net free ventilation per linear foot, 12 inches by 12 feet

5. Type: Smooth vented, provides 5 square inches of net free ventilation per linear foot, 16 inches by 12 feet
6. Type: Smooth vented, provides 5 square inches of net free ventilation per linear foot, 24 inches by 8 feet
7. Thickness: 1/4 inch

F. Trim:
1. HardieTrim boards as manufactured by James Hardie Building Products, Inc.
   a. Product: Batten Boards, 2-1/2 inch (63 mm) width.
   b. Product: 4/4 Boards, 3-1/2 inch (89 mm) width.
   c. Product: 4/4 Boards, 5-1/2 inch (140 mm) width.
   d. Product: 4/4 Boards, 7-1/4 inch (184 mm) width.
   e. Texture: Smooth.
   f. Length: 12 feet (3658 mm).
   g. Thickness: 3/4 inch (19 mm).
   h. Thickness: 1 inch (24 mm).
2. HardieTrim Fascia boards as manufactured by James Hardie Building Products, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Nominal 2 inch by 4 inch wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches face and straight, true, of uniform dimensions and properly aligned.
1. Install water-resistive barriers and cladding to dry surfaces.
2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
3. Protect siding from other trades.

D. Minimum 20 gauge 3-5/8 inch C-Stud 16 inches maximum on center or 16 gauge 3-5/8 inches C-Stud 24 inches maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where required. Minimum 1-1/2 inches face and straight, true, of uniform dimensions and properly aligned.
1. Install water-resistive barriers and cladding to dry surfaces.
2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
3. Protect siding from other trades.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install a water-resistive barrier is required in accordance with local building code requirements.

D. The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

E. Install Engineered for ClimateTM HardieWrapTM weather barrier in accordance with local building code requirements.

F. Use HardieWrapTM Seam Tape and joint and laps.

G. Install and HardieWrapTM flashing, HardieWrapTM Flex Flashing.

3.03 INSTALLATION - VERTICAL SIDING

A. Install materials in strict accordance with manufacturer's installation instructions.

B. Block framing between studs where HardiePanel siding horizontal joints occur.

C. Install metal Z flashing and provide a 1/4 inch gap at horizontal panel joints.

D. Place fasteners no closer than 3/8 inch from panel edges and 2 inches from panel corners.

E. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

F. Maintain clearance between siding and adjacent finished grade.

G. Specific framing and fastener requirements refer to Tables 2 and 3 in National Evaluation Service Report No. NER-405.

H. Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer's printed instructions.
   1. Touch-up nicks, scrapes, and nail heads in pre-finished siding using the manufacturer's touch-up kit pen.
   2. Touch-up of nails shall be performed after application, but before plastic protection wrap is removed to prevent spotting of touch-up finish.
   3. Use touch-up paint sparingly. If large areas require touch-up, replace the damaged area with new pre-finished siding. Match touch up color to siding color through use of manufacturer's branded touch-up kits.

3.04 INSTALLATION - TRIM BOARDS

A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.

B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

C. Place fasteners no closer than 3/4 inch and no further than 2 inches from side edge of trim board and no closer than 1 inch from end. Fasten maximum 16 inches on center.

D. Maintain clearance between trim and adjacent finished grade.

E. Trim inside corner with a single board trim both side of corner.

F. Outside Corner Board Attach Trim on both sides of corner with 16 gage corrosion resistant finish nail 1/2 inch from edge spaced 16 inches apart, weather cut each end spaced minimum 12 inches apart.

G. Allow 1/8 inch gap between trim and siding.

H. Seal gap with high quality, paint-able caulk.

I. Shim frieze board as required to align with corner trim..

J. Fasten through overlapping boards. Do not nail between lap joints.

K. Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten HardieTrim boards to HardieTrim boards.

L. Shim frieze board as required to align with corner trim.

M. Install HardieTrim Fascia boards to rafter tails or to sub fascia.

3.05 FINISHING

A. Finish un-primed siding with a minimum one coat high quality, alkali resistant primer and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

B. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

C. Field cut edges shall be coated during the installation process using an exterior grade primer/sealer that is compatible with the type of paint to used on project.

3.08 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion

END OF SECTION 07 46 46

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install metal flashing and sheet metal work specified.
   1. Flashing and Counter-flashing
   2. Gutter with Leaf Screen and Downspout
   3. Drip Edge
   4. Trim
   5. Cricket
   6. Chase Cover
   7. Other work indicated and required by project

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Job Supervision: Applicator of work in this Section to furnish competent, qualified foreman present and in charge at all times work is performed.

B. Applicable Standards:
   1. ANSI/SPRI/FM 4435/ES-1-11 “Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems”, and NRCA Guidelines for Complying With Building Codes Using ANSI/ SPRI ES-1. Provide shop drawings, to include wood blocking, to meet this standard or certified third party test data for gravel stop, fascia profiles and coping. Refer to the drawings for design wind load parameters. Include wind loads for roof area perimeters and corners on submittals.
   2. Refer to the current edition of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA). Use as applicable standard for method and quality of work under this Section where not specifically otherwise shown in Contract Documents. Manufacturer to provide trained metal craftsmen to supervise installation.

3. ASCE 7: Minimum Design Loads for Buildings and Other Structures.

4. ANSI/SPRI GT-1 2016 (R2022) - Test Standard for External Gutter Systems per Arkansas Code or the 2021 International Building Code.

1.05 WARRANTY

A. Provide manufacturer's guarantee for exterior color finish for a period of 20 years against blistering, peeling, cracking, flaking, checking, chipping and excessive color change and chalking. Color change not to exceed 5 NBS units (per ASTM D-2244.64T) and chalking not less than rating of 8 per ASTM D-659.

B. Guaranty: Guaranty sheet metal work installed under this Section against leakage or defects for 2 years after substantial completion date. Make good at Contractor expense leakage or defects occurring within this period.

PART 2 - PRODUCTS

2.01 SHEET METAL

A. G-60 Galvalume Steel: Aluminum-zinc alloy coating AZ50, meeting ASTM A792. Keep Galvalume dry during transit, in storage, and at work site.
   1. At locations where flashing is visible from outside building, finish to be Kynar 500® based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's complete line.
      a. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.
      b. Approved equal: Hylar 5000®.
   2. Provide mill finish at locations not visible from outside building or public view.

B. G-90 Bare Galvanized Steel: Conform to ASTM A525 General Requirements and to ASTM A526, Commercial Quality for hot-dip galvanizing (HDG) process. Zinc coating weight not less than 1-1/4 ounces per square foot nor more than 1-1/2 ounces per square foot of surfaces covered and conforming to ASTM A90, Table X1.1, measurement.

C. Aluminum Sheet: Provide 3003-0 alloy for flashings. For all other sheet metal work furnish 3003-14 alloy.
   1. Factory finish with oven cured Kynar 500® based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's complete line.
      a. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.
      b. Approved equal: Hylar 5000®.

D. Soft Temper Sheet Metal: Lead sheet, F.S. QQ-L-201, Grade B, 4 lb. per sq. ft.

E. Gauge of Metal:
   1. Metal components of a roof assembly: 24 gauge (USS .025") minimum
   2. Scuppers, guttering, downspouts and splash pans: 22 gauge (USS .0312") minimum. Gutter straps to be 18 gage.
   3. Through-Wall Flashing: 26 gauge minimum

2.02 GUTTER SYSTEM

A. Provide accessories for complete installation including end pieces, caps, elbows, outlet tubes, and basket type strainers. Conform to ANSI/SPRI GT-1 2016 (R2022) - Test Standard for External Gutter Systems per Arkansas Code (2021 IBC).

B. Manufactured from Galvalume sheet steel in minimum 10 foot lengths, tapered and notched to provide a 1" telescoping lap joint. Seal watertight, and secure with 1/8" rivets, or join sections with flat locked soldered seams.

C. Space gutter hangers and braces not more than 36" apart and secure with screws, bolts or approved clips. Brackets to be of compatible material to gutter, with matching finish and color.

D. Slope gutter 1" in 20 feet to down spout to avoid ponding.

E. Make leaders (downspouts) with 1-1/2" telescoped joints or full length without joints. Set leaders plumb, clear of walls. Secure with straps not over 6 feet apart and space so one is near top and another near bottom.

F. Finish: Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's standard line.

2.03 ACCESSORIES

A. Fasteners: All metal counter flashing and parapet cap flashing shall be attached with galvanized or cadmium plated screws with neoprene washers. Nails, screws and rivets used at other locations are to be the appropriate type for the purpose as described in the latest edition of the SMACNA Design Manual.

B. Solder for Lead: ASTM B 32, 50% tin and 50% lead used with rosin flux.

C. Roofing Cement: F.S. SS-C-153, Type I, Class A (summer grade) or Class B (winter grade) as applicable.

D. Bitumastic Coating: F.S. TT-C-494, MIL-C-18480, or SSPC - Paint 12, cold applied solvent type bitumastic coating for application in dry film thickness of 15 mils per coat.

2.04 FABRICATION

A. Fabricate all metal flashing, counter-flashing, trim and related items to comply with profiles and sizes required. Fabricate to comply with the latest edition of the SMACNA "Architectural Sheet Metal Manual", metal manufacturer's recommendations, and recognized industry practices.

B. For continuous running work, fabricate with expansion joints in flashing, spaced sufficiently close to prevent flashing damage and failure in resistance to water penetration. Form flashing to fit substrate in each application.

C. Where sheet metal is required and no material or gauge is indicated on the Drawings, furnish and install highest quality and gauge commensurate with the referenced applicable standard, (SMACNA Manual, latest edition).

2.05 OTHER MATERIALS

A. Provide materials, not specifically described but required for complete and proper installation of flashing and sheet metal, of new materials, first quality of their respective kinds, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection: Prior to work of this Section, carefully inspect installed work of other trades and verify work is complete to point where this installation may properly commence.

B. Discrepancies: Do not proceed with sheet metal installation in areas of discrepancy until discrepancies are resolved.

3.02 WORKMANSHIP

A. General: Form sheet metal accurately to dimensions and shapes required, watertight and weather-tight, with angles and broken surfaces true, sharp, and in straight lines. Where intercepting other members, cope to an accurate fit and solder securely. Produce flat surfaces free from waves and buckles.

B. Expansion: Allow a 3/8"-1/2" gap in coping caps between each section. Use 3-1/2" wide pre-finished 24 gage cover plate over joints.
   1. Set cover plates in visible bead of polyurethane sealant between the cap and cover plate. Wipe joints of excessive sealant.
   2. Attach cover plate at the front and back with hex head cadmium screws with neoprene washers, installed in the gap between the metal cap sections.
   3. Do not exceed maximum length of 10'-0" for cap, fascia and flashing sections. Furnish with factory formed slots or enlarged holes for fasteners.

C. Paint metal in contact with mortar, concrete, and masonry materials with an alkali-resistant coating. Use heavy-bodied bituminous paint or approved equal.

3.03 THROUGH-WALL FLASHING

A. General:
1. Install continuous through-wall flashing.
2. Where exposed portions are used as a counter-flashing, lap base flashing at least four inches and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing.
4. Terminate exterior edge beyond face of wall approximately 1/4-inch with drip edge where not part of counter flashing.
5. Turn back edge up 1/4-inch unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 2 inches into unit unless shown otherwise.
7. Under coping terminate both edges beyond face of wall approximately 1/4-inch with drip edge.
8. Lap end joints not less than four inches. Seal laps with sealant.
9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 1 inch and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 8 inches between masonry wythes or behind exterior veneer.

END OF SECTION 07 60 00

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish labor, materials, tools, and equipment required to completely close (with caulking compound or sealant) all joints to give a finished appearance. Items to be caulked or sealed include but are not limited to the following:
   1. Hollow metal frames.
   2. Exterior doors, louvers, windows and any other openings in exterior walls.
   3. Interior fixed glass.
   4. Penetrations by piping, conduit and similar items.
   5. Plumbing fixtures.
   6. Millwork.
   7. Flooring, including saw-cut concrete slab-on-grade.
   8. Paving and sidewalk joints.
   9. Dissimilar finishes.
   10. Joints shown on drawings or specified to be caulked or sealed.
   11. All joints or gaps between similar or dissimilar materials that do not receive closure trim are to be caulked/sealed with the appropriate material as listed in Part 2 of this Section.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Installer qualifications.

D. Contractor certification.

E. Manufacturer's installation instructions for each product used.

F. Cured samples of exposed sealants for each color.

G. Manufacturer's Literature and Data:
   1. Primers

2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

H. Manufacturer warranty.

1.04 REFERENCES

A. ASTM E84 (UL 723): Surface Burning Characteristics

B. ASTM E814 (UL 1479) and ULC-S115: Standard Test Method for Fire Tests of Through-Penetration Fire Stops

C. ASTM E1966 (UL 2079): Standard Test Method for Fire-Resistive Joint Systems

D. ASTM E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.05 QUALITY ASSURANCE

A. Qualifications of Applicators: Use workmen thoroughly skilled and specially trained in techniques of caulking, and completely familiar with manufacturer's published recommendations for caulking material used.

B. Rejection of Installed Caulking: Lack of skill by caulking installers is sufficient ground for Architect to reject installed caulking and to require its removal and complete recaulking at Contractor's expense.

C. Guarantee: Guarantee caulking materials and workmanship, in writing for 2 years after substantial completion date. Repair at Contractors expense any defects developing within guarantee period.

D. Submit manufacturer's product data sheets and color selection information for every brand and type of sealant, caulk and accessory item proposed for use on this project.

E. Refer to Underwriters Laboratories, Inc. (UL) Volume 2 with Hourly Ratings for Joint Systems, Through-Penetration Firestop Systems and Electrical Circuit Protective Systems and Duct Assemblies.

1.06 PRODUCT HANDLING

A. Protection: Protect caulking materials before, during, and after installation. Protect installed work and materials of other trades. In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

B. Storage: Store caulking materials and equipment under conditions recommended by manufacturer. Do not use materials stored for period of time exceeding maximum recommended material shelf-life.

1.07 JOB CONDITIONS

A. Inspection: Carefully inspect installed work of trades and verify work is complete to point where this installation may properly commence.

B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

C. Do not install sealants under adverse weather conditions, or when temperatures are not within manufacturer's recommended limitations for installation. Install sealants only when forecasted weather conditions are favorable for proper care and development of high early bond strength.

1.08 MOCK-UP

1. Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

PART 2 - PRODUCTS

2.01 MATERIALS FOR CAULKING AND SEALING

A. Select caulking materials for specific locations complying with manufacturer's recommendations. Provide caulking, sealant and accessory items in color(s) selected to match adjacent materials or as selected by Architect from manufacturer's complete line.

B. Silicone Sealant: Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 25.
   1. Silicone Sealant 790/791/795 by Dow-Corning Corp.
   2. Spectrum 1 by Tremco
   3. 890 FTS/864 NST by Pecora Corporation
   4. Approved Equal

C. Mildew-Resistant Silicone Sealant: Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 25.
   1. Silicone Sealant 786 by Dow-Corning Corp.
   2. Sanitary 1700 by GE.
   3. Approved equal.

D. Acrylic Latex Caulk (interior only): General purpose, gun grade, non-sag, paintable, non-staining latex sealant complying with ASTM C834.
   1. AC-20 + Silicone by Pecora.
   2. Acrylic Latex by Tremco.
   3. Approved equal.

E. Acoustical Sealant: General purpose, gun grade, non-sag, paintable, non-staining latex sealant complying with ASTM C834.
   1. SHEETROCK® Brand Acoustical Sealant by U.S. Gypsum
   2. AC-20® FTR Acoustical and Insulation Sealant by Pecora Corporation
   3. STOPGAP by Auralex Acoustics
   4. Sashco Big Stretch Caulk
   5. Green Glue Noiseproofing Sealant
   3. Approved equal.

F. Polyurethane Sealant (for vertical surfaces): Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 35.
   1. MasterSeal® NP 1™ (formerly Sonolastic® NP 1™).
   2. Vulkem 921 by Mameco.
   3. Dynatrol I by Pecora.
   4. Dymonic by Tremco.
   5. QSC-102 by Carlisle.
   6. Approved equal.

G. Polyurethane Sealant (for horizontal surfaces): Single component, non-priming, self-leveling, pourable grade product meeting ASTM C920, Type S, Grade P, Class 25.
   1. MasterSeal® SL 1™ (formerly Sonolastic® SL 1™).
   2. Vulkem 45 by Mameco.
   3. NR-201 by Pecora.
   4. THC-901 by Tremco.
   5. QSC-131 by Carlisle.
   6. Approved equal.

2.02 SEALANT BACKER RODS

A. Sealant Backer Rod for general use except at floor and deck joints: Tremco Open Cell Polyurethane, or approved equal, open cell type as recommended by sealant manufacturer for compatibility with sealant.

B. Sealant Backer Rod for use at horizontal floor and deck joints: MasterSeal® 920 by BASF, or approve equal closed cell type as recommended by sealant manufacturer for compatibility with sealant. MasterSeal® 921 by BASF may be used where appropriate.

C. Provide rod sized and shaped to control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed.

2.03 MISCELLANEOUS MATERIALS

A. Joint Cleaner Compound: Use type recommended by sealant and caulking compound manufacturer for joint surfaces to be cleaned.

B. Joint Primer/Sealer: Use type recommended by sealant manufacturer for joint surfaces to be primed or sealed.

C. Bond Breaker Tape: Use self adhesive polyethylene tape or plastic tape recommended by sealant manufacturer. Apply to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.

D. Joint Filler: W.R. Meadows, Sealtight Standard Cork, Expansion Joint Filler produced from clean, selected, granulated cork bonded with a phenolic resin, or approved equal meeting ASTM D 1752, Type II.

2.04 GENERAL APPLICATION GUIDE

A. Interior caulking, except joints with ceramic tile, metal, glass and aluminum: Acrylic Latex Caulk.

B. Sound rated walls, partitions and ceilings: Acoustical Sealant.

C. Interior and Exterior joints with metal, glass and aluminum: Silicone sealant.

D. Joints with ceramic tile and plumbing fixtures: Mildew resistant Silicone sealant.

E. Horizontal and Vertical building joints: Polyurethane sealant.

PART 3 - EXECUTION

3.01 CHOICE OF CAULKING MATERIAL

A. Use sealant and caulking materials best suited to the installation and recommended by caulking material manufacturer.

3.02 INSPECTION

A. Installer must examine substrates, (joint surfaces) and conditions under which joint sealer work is to be performed. Do not proceed with joint sealer work until unsatisfactory conditions are corrected.

3.03 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of gaskets, sealants and caulking compounds. Remove dirt, insecure coatings, moisture and substrates which could interfere with gasket seal and bond of sealant or caulking compound. Etch concrete and masonry joint surfaces when recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces recommended by sealant manufacturer.

B. Prime or seal joint surfaces where required, and when recommended by sealant manufacturer. Confine primer/sealer to areas of sealant bond. Do not allow spillage and migration onto adjoining surfaces.

3.04 INSTALLATION

A. Comply with manufacturer's printed instructions except when more stringent requirements are specified, and except when manufacturer's technical representative directs otherwise.

B. Set joint filler units at depth and position in joint as required to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.

C. Install sealant backer rod except when required to be omitted or recommended to be omitted by sealant manufacturer for application required.

D. Install bond breaker tape when required by manufacturer's recommendations to ensure liquid-applied sealants will perform as intended.

E. Employ proven installation techniques, which ensure sealants are deposited in uniform, continuous ribbon without gaps or air pockets, and with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise required, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints occur between a horizontal surface and vertical surface, fill joint to form a slight cove, so joint will not trap moisture and dirt.

F. Install liquid-applied sealant to depths required and as recommended by sealant manufacturer.

G. Spillage: Do not allow sealants and compounds to overflow from joint confines or to spill onto adjoining work, or to migrate into voids of exposed finished. Clean adjoining surfaces to eliminate evidence of spillage without damaging adjoining surfaces.

H. Recess edges of exposed joint fillers slightly behind adjoining surfaces, unless otherwise required, so compressed units will not protrude from joints.

I. At joints in face brick and precast concrete, apply sand and ground up mortar to uncured sealant to match appearance of mortar joints.

3.05 CURE AND PROTECTION

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Cure and protect sealants in manner which will minimize increases in modules of elasticity and accelerated aging effects.

END OF SECTION 07 92 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Provide hollow metal doors, door frames and window frames required.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. ANSI A224.1 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

B. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames.

C. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcements.

D. ANSI/ISDI-104 -Water Penetration Performance Standard for Insulated Steel Door Systems.

E. ANSI/ISDSI-103 - Acoustical Performance Standard for Insulated Steel Door Systems.

F. ANSI/ISDSI-105 - Mechanical Performance Standard for Insulated Steel Door Systems.

G. ANSI/SDI 100 - Recommended Specifications for Standard Steel Doors & Frames; Steel Door Institute.

H. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

I. ASTM B 117 - Standard Method of Salt Spray (Fog) Testing.

J. ASTM C 236 - Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box.

K. ASTM D 1735 - Standard Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.

L. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

M. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

N. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

O. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure.

P. NFPA 80 - Standard for Fire Doors and Windows.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

R. SDI 105 - Recommended Erection Instructions for Steel Frames

S. SDI 111 - Recommended Standard Details - Steel Doors and Frames.

T. SDI 113 - Test Procedure and Acceptance Criteria for Apparent Thermal Performance for Steel Door and Frame Assemblies.

U. SDI 114 - Test Procedure and Acceptance Criteria for Acoustical Performance for Steel Door and Frame Assemblies.

V. SDI 116 - Test Procedure and Acceptance Criteria for Rate of Air Flow Through Closed Steel Door and Frame Assemblies.

W. Warnock Hersey International Inc. (WHI) - Certification Listings.

X. Uniform Building Code (UBC).

Y. UL 10B - Standard for Fire Tests of Door Assemblies.

Z. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Underwriters Laboratory Inc.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Door Institute (SDI) or Hollow Metal Manufacturers Association (HMMA).

B. Use skilled workmen thoroughly trained and experienced and completely familiar with specified requirements and methods needed for proper performance of work of this Section.

C. Codes and Standards:
   1. Manufacture labeled units in strict accordance with specifications and procedures of Underwriters Laboratories, Inc. Labels must be affixed to rated assemblies.
   2. In guarantee and Shop Drawings, apply and use definitions and nomenclature established in American National Standards Institute publication A 123.1 "Nomenclature for Steel Doors and Steel Door Frames."
   3. ANSI/SDI A250.8-2017 - Specifications for Standard Steel Doors and Frames.
   4. Fire-Rated Units: **Affix metal plates to jamb side or top of door and/or frame stating the appropriate fire rating. Paper labels will not be accepted. Do not apply paint or stain over metal labels. Mask off the label before applying finish and remove masking after finish is dry.**

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection:
   1. Deliver, store, and handle hollow metal units to prevent damage and deterioration.
   2. Provide packaging of cardboard or containers, separators, banding, spreaders, and paper wrappings to completely protect hollow metal units during transportation and storage.
   3. Store units upright, in protected dry area, at least one inch off ground and with at least 1/4" air space between individual pieces. Protect primed and hardware surfaces.
   4. Protect installed work and materials of other trades.
   5. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4" spaces between stacked units to promote air circulation.

B. Replacements: Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equal in all respects to new work, otherwise, remove and replace damaged items as directed at Contractor's expense.

1.07 WARRANTY

A. Provide Manufacturer's standard warranty, effective on date of purchase, against defects in product workmanship and materials; minimum 12 months for doors and frames.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fabricate hollow metal items rigid, neat in appearance, and free from defects, warp, or buckle.

B. Provide clean cut, straight and true molded members with well-formed and aligned miters.

C. Dress exposed weld joints smooth for a seamless appearance at frames. **[and doors.]** Provide interlocking visible edge seams at door panel corners, not at middle of door edge.

D. Door Clearances: Maximum 1/8" at jambs and heads, 1/8" at meeting edges of pairs of doors, and 3/4" at bottom from finished floor line.

E. Close top and bottom edges of exterior doors flush. Seal against water penetration with flush steel channel fillers.

2.02 ACCEPTABLE MANUFACTURERS

A. Provide hollow metal units by the following or other approved equal manufacturer:
1. National Custom Hollow Metal, 800-334-3070. Exterior doors and frames; (Interior doors and frames optional).
2. Amweld
3. Ceco Door Products
4. Curries Company
5. Mesker Door
6. Pioneer

2.03 FACTORY PREPARATION

A. Prepare units to receive hardware scheduled in "Hardware" Section of these specifications and in accordance with ANSI/DHI A 115.

B. Cut, mortise, reinforce, drill, and tap units at factory, except drill and tap for surface applied hardware at job when hardware is applied.

C. Prepare door frames for rubber silencers to be provided with frames.

2.04 SHOP PRIME COAT FOR FIELD FINISHED DOORS AND FRAMES

A. Clean, treat, and prime exposed surfaces of hollow metal units, including galvanized surfaces. All exterior doors and frames shall be galvanized.

B. Clean steel surfaces free of mill scale, rust, oil, grease, dirt, and foreign materials before applying paint.

C. Apply shop coat of rust-inhibiting prime paint of even consistency to provide uniformly finished surface ready to receive finish paint.

2.05 WELDED DOOR/WINDOW FRAMES

A. Construct exterior/interior welded door frames to the designs and gages specified:
   1. **Exterior Door/Window Frames and designated wet areas:** Hot dipped galvannealed steel, ASTM A 653, ZF180, Class A60 coating, 16 gauge Extra Heavy Duty (except where heavier gauge required), with closed tops.
      a. Include galvannealed components and internal reinforcements.
      b. **Overhead Rain Drip Guard:** Provide Anodized or Dark Bronze Aluminum Drip Strip 1.5" high x 2.5" wide x required length(s) by NGP, including stainless steel furnished fasteners. Coordinate with Door Hardware Schedule in Section 08 71 00 - Door Hardware. Rain Drip not required where exterior cover provided.
   2. **Interior Door/Window Frames:** Hot Dipped galvannealed steel, ASTM A 653, ZF120, Class A40 coating, 18 gauge Heavy Duty (except where heavier gauge required), with no exposed face seams.

B. Secure headers and jambs at corners by external welding of faces. Grind smooth to provide invisible joints.

C. Provide frames with minimum of 3 anchors per jamb for adjoining wall construction and floor anchors for attachment at floor. Construct anchors using minimum 18 gauge steel.

D. For frames that are to receive concealed closer(s) mounted in the head; provide a cover box to attach to the inside of the frame that will completely cover and protect the closer.

D. At fire rated openings, furnish frames bearing Underwriters Laboratories, Inc. or Warnock-Hersey, International, Inc. label for fire rating required with anchors approved for type installation required.

2.06 FIXED GLASS METAL FRAMES

A. Fabricate hollow metal framing using 14 gauge cold rolled steel conforming to ASTM Designation A 366. Apply steel tube glass stops with flush head, countersunk screws, spaced maximum of 12" o.c. unless otherwise required. Fit joints neatly, miter at corners, and make welds invisible by grinding smooth. Provide tamper-proof type anchors.

B. Anchor frames to wall construction with anchors set not less than 2'-0" o.c. around perimeter of frame.

C. Glass requirements specified in Section 08 80 00.

D. At fire rated openings, furnish frames bearing Underwriters Laboratories or Warnock-Hersey International, Inc. label for fire rating required with anchors approved for type installation required.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions for work of this Section. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install hollow metal units in strict accordance with approved Shop Drawings and manufacturer's recommendations.

B. Set frames accurately, plumbed, aligned, and securely anchored.

C. Install finish hardware in strict accordance with manufacturers' recommendations. Eliminate hinge-bound conditions, making items operate smoothly with secure locking and latching.

3.03 ADJUST AND CLEAN

A. Immediately after installation, sand smooth rusted and damaged prime coat. Apply compatible touch-up air-drying primer.

B. Check and adjust operating finish hardware items, leaving hollow metal units undamaged and in proper operating condition.

C. Excessive filing or grinding of strike plate will not be accepted. Filing and grinding not to exceed 1/8" in any direction.

END OF SECTION 08 11 13

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install doors, frames of FRP composite construction in accordance with details and schedule shown on the project drawings and as specified herein. Door and frame products of aluminum, steel or wood constructions that use FRP face sheets are strictly excluded.

B. FRP is defined as “Fiberglass Reinforced Polyester”

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Product Data: Provide catalog cut of FRP door detailing internal construction and reinforcements, materials used and description of molding process.

D. Shop Drawings: To include the following specific information:
1. Specifications relating to FRP door thickness, resin type, core material, method of construction, finish color, type of glass and glazing, anchor systems, joint construction and complete warranty information.
2. Complete schedules or drawings of FRP doors and frames (and associated Builders Hardware) showing identifying mark numbers, door and frame types, typical elevations, nominal sizes, handing, actual dimensions and clearances, and required hardware preps and reinforcements.
3. Supporting reference drawings pertaining to frame mounting details, door lite or louver installation, hardware locations, and factory hardware cutouts and reinforcements.

E. Color Samples: Provide a complete set of available finish colors from the manufacturer for color selection upon request. **3 stock and 24 pre-matched colors available.**

F. Installation instructions: Include manufacturer’s specific information describing procedures, sequence and required fasteners for frame and door installation.

G. Production of FRP doors and frames shall not proceed until final approval of submittals and all necessary manufacturing information is received from customer.

1.04 RELATED SECTIONS

A. Section 04 05 13: Masonry Mortaring

B. Section 05 50 00: Steel lintels

C. Section 06 20 23: Interior Finish Carpentry

D. Section 08 14 00: Wood Doors

E. Section 08 71 00: Door Hardware

F. Section 08 80 00: Glazing

1.05 QUALITY ASSURANCE

A. Referenced Standards
   1. American Society for Testing and Materials (ASTM)
   2. Society of Automotive Engineers (SAE)
   3. International Building Code, Plastics (Chapter 26)
   4. UL Standards for Safety UL10B / UL10C, UBC 7-2
   5. ANSI A250.4 1,000,000 cycle test

B. Experience: Manufacturer shall be engaged in the manufacture of FRP door and frame systems for a minimum of twenty five (25) years documented experience prior to the start of this work, and who has a history of successful production acceptable to the Architect.

C. Referenced Standard: Where labeled fire doors are required, Fiberglass Doors and frames shall be UL listed and shall be tested successfully to UL10B / UL10C, UBC 7-2 standards.

D. Process: Certify that FRP doors are manufactured via press-molding technology.

E. Warranty: Provide written limited guarantee for FRP doors and frames as follows:
   1. Heavy Duty doors are guaranteed for the life of the product against delamination and failure due to corrosion from the specific chemical environment named at the time of purchase. Furthermore, all products are inspected prior to shipment and guaranteed against defective workmanship for a period of ten (10) calendar years after the date of purchase.

1.06 DELIVERY, STORAGE AND HANDLING

A. FRP doors and frames are to be delivered to jobsite in adequate crating with foam sheet separations between all components.

B. Upon receipt of shipment, remove and inspect the doors and frames for damage. Note any damage on the shipping papers prior to accepting. If there is any noted (visible or concealed) damage, notify Tiger Door at 1-888-891-4416, immediately.

C. Handling and storage of the doors and frames after receipt is the responsibility/liability of the customer. It is recommended that the doors be stored indoors in a vertical position, clear of the floor, with blocking between the doors to permit air circulation between the doors and prevent damage to the door faces. Rain/water or condensation must not be allowed to collect or lay between stored doors. Do not wrap in plastic sheeting as it will promote condensation formation within. Permanent discoloration can result. Failure to comply with the receiving and reporting instructions shall void the Tiger Door warranty.

D. Use care in handling FRP doors and frames to prevent damage to factory finishes. Wear protective gloves and do not slide or drag doors or frames against one another.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. FRP Doors and Frames shall be as manufactured by Tiger Door, 5224 FM 802 Brownsville, TX 78521. ph 888-891-4416, www.tigerdoor.com

2.02 FRP DOORS

A. Heavy Duty FRP Doors

1. Design: FRP doors shall be of seamless press-molded construction. Laminated FRP face sheets shall be applied while wet and uncured to an internal door stile and rail subframe/core assembly and then press molded under heat and pressure. The composite door panel must be integrally fused over its entire surface area, not just adhesive-bonded at perimeter stiles and rails. Doors shall remain under pressure during curing for flat, warp-free surfaces.
2. Stiles & Rails: A high-modulus pultruded FRP square or rectangular tube subframe is to be provided within the door. Tubes are to be mitered and joined internally at the corners with solid polymer blocks to yield a one-piece unit that does not require any secondary external sealing. Provide a tubular midrail across width of door at lock height, and additional horizontal rails where specific design conditions dictate. Doors shall incorporate molded-in FRP edge strips, chemically bonded to the subframe stiles, for machining of hardware mortises so as not to cut or otherwise compromise the integrity of the pultruded stiles, nor allow moisture to penetrate into the core of the door. All connections shall be chemically welded. No mechanical fasteners will be allowed. The use or inclusion of aluminum, steel, gypsum or wood into stile and rail construction is not permitted.
3. Core: For maximum rigidity and compressive strength a triangular shaped 3/8” cell phenolic resin impregnated kraft paper honeycomb core shall be used. Molding pressure and resin gel time shall be sufficient to allow for penetration

of resin into the cellular structure of the core to maximize shear and peel strengths at the skin/core interface and eliminate the possibility of delamination. The honeycomb is to be completely enclosed within the stile and rail subframe. Use of balsa wood is not permitted.

4. Internal Reinforcement: High-modulous pultruded tubular FRP, high-density polymer compression blocks, or plastic compression blocking at all hardware locations, and corner locations. No wood blocking, steel or aluminum reinforcing plates, ribs or fittings shall be used. A minimum of 900 lbs of pullout strength is required for each factory supplied hinge screw.
5. Faces: Door facings shall utilize a chemical resistant thermosetting polyester resin system with fiber reinforcing layers. Supplier shall furnish door faces as shown on the drawings and in the door elevations. Chopped strand mat layers shall be used to provide bond integrity between gelcoat, laminated facings and the internal door structure. Structural reinforcement shall be in the form of a knitted multi-layer material with layers of uni-directional glass fiber oriented in both the vertical and horizontal directions for high stiffness, impact resistance and resistance to warping. Gelcoat surface integrally molded to be 25/30 mils thick (wet) ultra-violet light stabilized marine grade NPG-isophthalic polyester gelcoat.
6. Finish: The exposed FRP door faces shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Coating shall have a minimum hardness of H to 2H. Finish shall be a slightly textured semi-gloss to minimize the visual effects of wear and tear.
    a. **COLOR: Saddle Tan** to be approved by the owner and selected from 24 pre-matched colors offered by the manufacturer.
7. Astragals: All pairs of doors shall be furnished with an astragal from door manufacturer made of same pultruded FRP material as door stile, rail and edge as required. Astragal shall be located on the meeting stile edge of each inactive leaf of double door pairs. Architect shall advise active leaf of door, and astragal shall be installed to cover meeting stile gap to effect seal and security.
8. Lites: Glass per job specification shall be factory furnished, glazed and installed. Standard glass thickness is ¼". Centered glazing shall be installed between 45 degree pultruded FRP glazing stops and vinyl foam tape with concealed compression retainers for ¼" glazing. No exposed fasteners or exposed silicone will be allowed for securing ¼" glazing. Stainless steel screws may be allowed for other glazing thicknesses. All glazing stop material shall be pultrued FRP with a minimum fiberglass content of 50%. Metal, pvc, or vinyl "Glass Kit" type lites are not acceptable for non-fire rated openings.
9. Louvers: Fiberglass inverted V blade privacy or flat blade louvers shall be factory furnished and installed. All louvers and louver trim shall be manufactured exclusively from putruded FRP profiles with a minimum fiberglass content of 50%. All louvers shall be coated to match door in color and sheen. Inverted V blade minimum thickness shall be 3/32" thick, flat blade louver minimum thickness shall be 3/16" thick. Adhesives for louver assembly shall meet or exceed all requirements set forth in section 2.05.1 Mechanical Properties and test performance. Metal, pvc, vinyl or other non-fiberglass louvers are not acceptable for non-fire rated openings.

10. Raised panels and plants: All doors shown in elevation to have raised panels or plants shall be equipped with plants in configuration as shown on plans and in door schedule. Plants shall be applied by the door manufacturer as an integral part of the door face. Plants shall be bonded to the door skin; no mechanical fasters shall be permitted. All applied moldings shall be of resin material, and shall be installed by the manufacturer to resemble a raised panel door. Field applied plants or moldings shall not be acceptable.
11. Provisions for lites and louvers shall be performed during manufacture and shall not be attempted in the field. Cutouts are to be totally enclosed by pultruded FRP stiles and rails incorporated into the door structure. Lite and louver cutouts that expose core material are not acceptable.

2.03 FRP FRAMES

A. FRP Frames:
1. Design: FRP Door frames furnished under this specification shall utilize a high-modulus pultruded structural FRP shape. The frame section shall be standard double rabbeted 5-3/4" deep x 2" face, 3/16" thick, with integral 5/8" doorstop, to match typical hollow metal configurations. Additional jamb profiles and widths are available.
2. Corner Joints: Frame jambs and header shall be joined at corners via miter connections with hidden FRP angle clips and associated fasteners. Post and beam corners will not be acceptable.
3. Hardware Reinforcements: FRP reinforcing shall be chemically welded to door frame material at required locations. Minimum screw pullout strength of 1100 lb per #12 x 1-1/4" sheet metal screw is required. Mechanically fastened reinforcements are not permitted.
4. Anchors:
   a. BOLT-IN: Provide manufacturer's required number of 3/8" diameter x 4" long flat head stainless steel sleeve anchors for masonry openings, 3/8" diameter x 4" machine screw with nut and washers for structural steel openings, #14 x 4" stainless steel flat head sheet metal screws for wood or steel stud openings. Include extra anchors for additional frame height in two foot increments above 8'-0". Provide single bolt anchor at center of all headers over four feet in nominal width. Stainless Steel fasteners shall be furnished by the factory.
   b. GROUT-IN: Provide manufacturer's required number of wire or strap type masonry anchors for installation into block wall. Fill frame cavity with grout.
5. Finish: Frames shall have a 3-4 mils (wet) factory applied two-part aliphatic polyurethane fully cured coating of industrial urethane. Industrial urethane chemical coating color topcoat, to match the color and sheen of the doors, for superior weatherability. Gelcoat may not be sprayed onto the frame as a secondary coating.
   a. **COLOR: Saddle Tan** to be approved by the owner and selected from 24 pre-matched colors offered by the manufacturer.

2.04 MECHANICAL PROPERTIES AND TEST PERFORMANCE

A. Pultruded structural shapes for stiles; rails, frames, and astragals shall exhibit the following minimum longitudinal coupon properties (per ASTM):
   1. Tensile strength (D638) 30,000 psi
   2. Comprehensive strength (D695) 30,000 psi
   3. Flexural strength (D790) 30,000 psi
   4. Flexural modulus (D790) 1,600,000 psi
   5. Shear strength (D2846) 4,500 psi
   6. Impact, notched (D256) 25 ft-lb/in
   7. Barcol hardness (D2853) 50

B. Core material shall exhibit the following minimum coupon properties (per ASTM):
   1. Shear strength, longitudinal direction (C273) 68.2 psi
   2. Shear strength, transverse direction (C273) 25.8 psi
   3. Shear modulus, longitudinal direction (C273) 6940 psi
   4. Shear modulus, transverse direction (C273) 1878 psi
   5. NA
   6. Shear elongation, longitudinal direction (C393 short beam) 1.79%
   7. Shear elongation, transverse direction (C393 short beam) 2.72%
   8. Maximum facing stress, longitudinal direction (C393 short beam) 735 psi
   9. Maximum facing stress, transverse direction (C393 short beam) 289 psi
   10. Maximum core shear stress, longitudinal direction (C393 short beam) 63.8 psi
   11. Maximum core shear stress, transverse direction (C393 short beam) 24.9 psi
   12. Modulus of elasticity (EI) per 1" width, longitudinal direction (C393 short beam) 4.92E+04 psi
   13. Modulus of elasticity (EI) per 1" width, transverse direction (C393 short beam) 1.97E+04 psi
   14. Maximum facing stress, longitudinal direction (C393 long beam) 9011 psi
   15. Maximum facing stress, transverse direction (C393 long beam) 4727 psi
   16. Maximum core shear stress, longitudinal direction (C393 long beam) 48.3 psi
   17. Maximum core shear stress, transverse direction (C393 long beam) 23.5psi
   18. Modulus of elasticity (EI) per 1" width, longitudinal direction (C393 long beam) 1.14E+05 psi
   19. Modulus of elasticity (EI) per 1" width, transverse direction (C393 long beam) 7.23E+05 psi
   20. Stiffness "D", longitudinal direction (C393 long beam) 379,270 psi
   21. Stiffness "D", longitudinal direction (C393 long beam) 260,608 psi
   22. Compressive strength (C365) 53 psi
   23. Compressive modulus (C365) 2110 psi
   24. Density (C271) 2.42 lb/ft3

C. Adhesive shall exhibit the following minimum coupon properties (per SAE)
   1. Tensile Strength (D882-83A modified) minimum 2000 psi
   2. 8 day 25° C at 100% humidity Cross Peel (SAE J1553) minimum 330 psi
   3. 7 day immersion in seawater Cross Peel (SAE J1553) minimum 330 psi
   4. 30 day immersion in saltwater Cross Peel (SAE J1553) minimum 330 psi
   5. 72 hour immersion in gasoline Cross Peel (SAE J1553) minimum 330 psi

6. 72 hour immersion in 20% sulfuric acid Cross Peel (SAE J1553) minimum 300 psi

D.. ANSI A250.4 1,000,000 cycle test

1. 4' x 8' door (up to a full lite) and frame successfully tested in excess of 1,000,000 cycles with no failure of any of the design features of the door or frame.

2.05 FASTENERS

A. All fasteners for all hardware shall be type 304 CRSS (18-8 series corrosion resistant stainless steel) with no exception. No carbon steel or aluminum components shall be used.

2.06 HARDWARE

A. Doors shall be factory mortised and drilled for mortise template butt hinges, with #12 x 3" long stainless steel screw for hinge attachment. Provide 161 cylindrical lock bore, rim deadbolt, ANSI 86 mortise lock edge prep and pocket, or flushbolt cutouts as required.

B. Frames shall be factory machined and drilled for all hardware requiring mortises, with #12 x 1-1/4" long stainless steel screws for hinge attachment.

C. Hardware shall be furnished as listed in section 08 70 00 or as so designated in appropriate section, and shall be coordinated by GC and installed by experienced mechanics.

D. Supplier shall furnish manufacturer's standard templates, installation instructions, or full size approved door and frame preparation instructions as approved by the architect and as required by door and frame manufacturer prior to door and frame factory initiated manufacture. Standard factory lead-time for production of FRP doors and frames shall commence only and when all distributor required preparation information is received and acknowledged by the door and frame manufacturer.

PART 3 - EXECUTION

3.01 IDENTIFICATION

A. Factory mark all doors and frames using a chemical resistant plastic tag or indelible marker with identifying number, keyed to shop drawings, prior to shipment.

3.02 INSTALLATION

A. Frames: Install in strict accordance with manufacturer's printed instructions. Set plumb and square, using shims for bolt-in of existing openings, or wood bracing prior to grouting of jambs. Use at least two 2x6 wood spreaders inside frame to maintain critical opening dimensions during grouting.

B. Doors: Hang per manufacturer's printed instructions using special screws provided for hinge attachment. Install doors to swing freely and to stand open at any angle. After installation make final adjustments to hardware to allow for proper door operation and latching. All surface applied hardware shall be thru bolted.

3.03 CLEANING

A. Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

END OF SECTION 08 16 13.13

(This Specification Section applies only to the Observation Windows at the Dayroom Animal Viewing locations and Anteater Habitat where indicated on the Drawings.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes: Aluminum-framed storefront systems.
   1. Exterior Thermally Broken Storefront Frames for Animal Viewing Glazing Applications at the Dayroom Animal Viewing Locations: Type SF-1.
   2. Exterior Non-Thermally Broken Storefront Frames for Animal Viewing Glazing Applications at the Anteater Habitat Location: Type SF-2.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:
   1. Plans, elevations, sections, full-size details, and attachments to other work.
   2. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Delegated Design Submittals: For aluminum-framed storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Source quality-control reports.

D. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer.

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of aluminum-framed storefront systems that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed storefront systems.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefront systems representing those indicated for this

Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure Also Includes the Following:
    a. Thermal stresses transferring to building structure.
    b. Glass breakage due to thermal stresses, wind loads, and/or animal impacts.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4-inch for spans greater than 13 feet 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8-inch.

E. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies and anchorage do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure (SF-1): Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

G. Energy Performance (SF-1): Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41-Btu/sq. ft. x h x degrees F as determined in accordance with NFRC 100.
2. Solar Heat-Gain Coefficient (SHGC):
    a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.45 as determined in accordance with NFRC 200.

3. Air Leakage:
    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06-cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
4. Condensation Resistance Factor (CRF):
    a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 ALUMINUM-FRAMED STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Arcadia Inc.
2. Kawneer Company, Inc.; Arconic Corporation.
3. OldCastle BuildingEnvelope (OBE).
4. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken: (SF-1).
2. Exterior Framing Construction: Non-thermally broken (SF-2).
3. Glazing System: Retained mechanically with gaskets on 4 sides.
4. Finish: Powder-coat finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.
8. Aluminum framing system for observation storefront system shall be equal to Kawneer 501T Impact SF framing system for SF-1, and Kawneer 501 framing system for SF-2.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00.1 "Animal-Viewing-Window Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:
   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. 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.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

2.7 ALUMINUM FINISHES

A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION OF ALUMINUM-FRAMED STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

K. Install glazing as specified in Section 08 80 00.1 "Animal-Viewing-Window Glazing."

END OF SECTION 08 41 13.1

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the following:
   1. Curb-mounted insulating glass glazed unit skylights.
      a. Velux Model GSM with 1-1/16" insulating glass or approve equal.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Division Six Section "Rough Carpentry" for wood curbs and nailers.
   2. Division Seven Section "Roof Accessories" for curbs, roof hatches, and smoke vents.
   3. Division Seven Section "Flashing and Sheet Metal" for metal flashing for skylights.
   4. Section 08 80 00 - Glazing. Skylight glazing submission shall be identified or referenced at same time.

C. Refer to roofing system sections for roofing accessories to be built into the roofing system to accommodate work of this section.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Product Data Sheet: For each type of skylight specified, include details of construction and installation, relative to applicable roofing materials.

D. Samples for Selection: Manufacturer's color charts showing a full range of colors available for each type of skylight glazing and aluminum finish.

1.04 PERFORMANCE REQUIREMENTS

A. General: Provide unit skylights capable of withstanding loads as defined by the local codes having jurisdiction where units are to be installed without failure.

B. Units shall be tested to compliance with AAMA\WDMA\CSA\101\I.S.2\A440 as required by the International Building Code.

C. Provide units tested to AAMA\WDMA\CSA\101\I.S.2\A440 with the following rating: SKG-PG80 1803 x 1803 (71 x 71).

1.05 WARRANTY

A. General: Warranties specified in this section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Skylight Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship and guaranteeing weather-tight and leak-free performance. “Defects” is defined as uncontrolled leakage of water and abnormal aging or deterioration.
   1. Warranty Period: 2 years from date of Substantial Completion.

C. Glass Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work that has or develops defects in the insulating glass. “Defects” is defined as seal failure or delamination.
   1. Warranty Period for Insulating Glass: 5 years from date of Substantial Completion.

D. Finish Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work with finish defects. “Defects” is defined as peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.
   1. Warranty Period for Anodized Finish: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by VELUX America Inc., Greenwood, SC 29648; www.VELUXusa.com; (800) 878-3589, specifcations@VELUXusa.com or approved equal:
   1. Flat Glass type, TCM - Thermally Broken Curb Mounted Frame Only. Unit skylights shall be manufactured by Skyline Sky-Lites, 2925 Delta Drive, Colorado Springs, CO 80910, Tel: (866) 625-1330.
      a. Frame Style: Thermally broken Aluminum Insulated curb frame, 9" tall fabricated from .040" mill finish aluminum exterior wall, 1 1/2" thick rigid insulation and an .025" aluminum well liner to match frame finish. Mounting flange to be 2" wide. Skylight frame shall be of 6063-T5 aluminum with a.070" thick base frame incorporating a poured in place polyurethane thermal barrier, and a .062" thick retaining angle. All

corners shall be welded. Vinyl gasket shall be used between the frame and the glazing to form a tight seal. Skylight shall be completely assembled by the manufacturer and ready for installation directly to the roof deck.

b. Model CM-Frame sizes are 2828 with 25-1/2" x 25-1/2" outside curb and 2878 with 25-1/2" x 72-3/4" outside curb. Refer to drawings.

B. Substitutions: Manufactures shall not be considered without prior approval in writing no later than ten (10) calendar days prior to bid. Substitute manufacturers must have been in the custom skylight business for not less than a period of 15 years and must submit to the Architect the following:

1. List of similar projects successfully completed within the last five years.
2. Proof of financial capability.
3. Complete details of proposed skylight.
4. Complete specifications for Architect's review.

2.02 MATERIALS

A. Curb Frame: Bright white high performance PVC with neutral gray cap stock and minimum effective external wall thickness of 0.060 inch (1.5mm). Provide integral condensation gutter system with corners fully welded for waterproof quality.

B. Retainer Frame: Extruded neutral gray aluminum alloy 6063-T5 (min). ASTM B 221 (ASTM B 221 M) with minimum effective thickness of 0.060 inch (1.5 mm).

1. Curbs: Minimum 1 ½" wide field built or pre-fabricated curb (By Others)

C. Thermal Break: Fabricate skylight units with thermal chambered PVC frame.

D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non corrosive metal as recommended by manufacturer

2.03 INSULATING GLASS SKYLIGHT UNITS

A. General: Factory-assembled, curb-mounted unit consisting of insulating glass, gasketing, and inner frame designed to mount on separate curb.

1. Products: Provide Model GSM meeting the requirements of this section.

B. Curb: Minimum 1-1/2"" wide field built or pre-fabricated (By Others).

C. Condensation Control: Fabricate skylight units with integral internal gutters to collect condensation.

D. Thermal Break: Fabricate skylight units with thermal chambered PVC.

E. Shape and Size: As indicated by model number. Custom sizes available, not to exceed 32 SF.

F. **Laminated Sloped and Overhead Glazing for Skylights:** 1-1/16" IGU comprised of a 1/4" tempered clear (non low-e), 3/8" air, and an inner pane of clear heat strengthened laminated glass with SentryGlas® Natural UV interlayer as supplied by Kuraray America, Inc., 800-635-3182. www.trosifol.com
    a. Provide 35/25 with 35% Visible Light Transmission and 0.25 Solar Heat Gain Coefficient (SHGC).

2.04 FABRICATION

A. Framing Components: As follows:
    1. Factory fit and assemble components.
    2. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
    3. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at skylight perimeter.
    4. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
    5. Fit and secure PVC frame joints by thermal welding.
    6. Fit and secure aluminum retainer joints with corner keys.

2.05 ALUMINUM FINISHES

A. General: Comply with NAAMM “Metal Finishes Manual” recommendations for application and designations of finishes.

B. Finish designations prefixed by AA conform to the system for designations of aluminum finishes established by the Aluminum Association.
    1. Clear-Anodized Finish, Class I: AA-C22A41 complying with AAMA 611.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.
    1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Comply with manufacturer’s written instructions for protecting, handling, and installing skylight components.

B. Coordinate with installation of roof deck and other substrates to receive skylight units.

C. Coordinate with installation of vapor barriers, roof insulation, roofing, and flashing as required to assure that each element of the work performs properly and that combined elements are waterproof and weather tight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses ass well as inward and outward loading pressures.

D. Counter Flashing: Where counter flashing is required as component of the skylight, install to provide an adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

3.03 CLEANING AND PROTECTION

A. Clean exposed metal and glass surfaces according to manufacturer's instructions during installation. Touch up damaged metal coatings.

B. Final cleaning by others.

END OF SECTION 08 60 00

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PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature

4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

3. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:

1) Door Index: door number, heading number, and Architect's hardware set number.
2) Quantity, type, style, function, size, and finish of each hardware item.
3) Name and manufacturer of each item.
4) Fastenings and other pertinent information.
5) Location of each hardware set cross-referenced to indications on Drawings.
6) Explanation of all abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for hardware.
8) Door and frame sizes and materials.
9) Degree of door swing and handing.
10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
    1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    2) Preliminary key system schematic diagram.
    3) Requirements for key control system.
    4) Requirements for access control.
    5) Address for delivery of keys.

2. Pre-installation Conference
    a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Inspect and discuss preparatory work performed by other trades.
    c. Inspect and discuss electrical roughing-in for electrified door hardware.
    d. Review sequence of operation for each type of electrified door hardware.
    e. Review required testing, inspecting, and certifying procedures.
    f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
    a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
   a. Mechanical Warranty
      1) Locks
         a) Schlage L Series: 10 years
      2) Closers
         a) LCN 4000 Series: 30 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series
   b. McKinney TB series
   c. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series

2. Acceptable Manufacturers and Products:
   a. Sargent 8200 series
   b. Best 45H series
   c. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.

5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
   a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
   b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
   c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
   d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
   e. Connections – provide quick-connect Molex system standard.

8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.05 CYLINDERS

a. Open: cylinder with small format interchangeable core (SFIC) core with open keyway

2.06 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. <EXISTING UNKNOWN KEY SYSTEM>

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.07 KEYING

A. Scheduled System:

1. Existing non-factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:
   1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
   2) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

d. Quantity: Furnish in the following quantities.
   1) Master Keys: 6.
   2) Change Keys: 3 per cylinder/core that is keyed differently.
   3) Key Blanks: Quantity as determined in the keying meeting.

2.08 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
   a. Corbin-Russwin DC8000 series
   b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.09 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.10 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. Sargent
   c. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.11 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumb turn.

2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other, and overhead stop cannot be used.

2.12 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Reese
   c. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.13 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Burns
   b. Rockwood
   c. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.14 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

K. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

HARDWARE GROUP NO. 001-EX

FOR USE ON DOOR #(S):
301 302 304

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR

-EXISTING DOOR, FRAME AND HARDWARE TO REMAIN
-GENERAL CONTRACTOR TO VERIFY AND INSPECT IN FIELD ALL EXISTING HARDWARE FOR PROPER OPERATION. NOTIFY ARCHITECT IMMEDIATELY OF ANY INCOMPATIBILITY OR DEFICIENCY.

HARDWARE GROUP NO. 103

FOR USE ON DOOR #(S):
403

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 06A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 105

FOR USE ON DOOR #(S):
103 305 403A 403B 501 504
509 519

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CORRIDOR LOCK	L9456L 06A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK (HEAD & JAMBS)	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 105I

FOR USE ON DOOR #(S):
401

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	CORRIDOR LOCK	L9456L 06A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	RAIN DRIP	141AA X END CAPS	AA	ZER
1	SET	GASKETING	328AA (HEAD & JAMBS)	AA	ZER
1	EA	DOOR BOTTOM	366AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 105IW

FOR USE ON DOOR #(S):
107 205A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	630	IVE
1	EA	CORRIDOR LOCK	L9456L 06A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	141AA X END CAPS	AA	ZER
1	SET	GASKETING	328AA (HEAD & JAMBS)	AA	ZER
1	EA	DOOR BOTTOM	366AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 165IW

FOR USE ON DOOR #(S):
108 201

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	630	IVE
1	EA	CORRIDOR LOCK	L9456L 06A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	OH STOP & HOLDER	100H SIZE AS REQ	630	GLY
1	EA	RAIN DRIP	141AA X END CAPS	AA	ZER
1	SET	GASKETING	328AA (HEAD & JAMBS)	AA	ZER
1	EA	DOOR BOTTOM	366AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 201C

FOR USE ON DOOR #(S):
303

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 205

FOR USE ON DOOR #(S):
104 402

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	EA	GASKETING	188SBK (HEAD & JAMBS)	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 205W

FOR USE ON DOOR #(S):
201A 204

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080L 06A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA DW + 4" (OMIT @ COVERED OPENINGS)	AA	ZER
1	EA	GASKETING	188SBK (HEAD & JAMBS)	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 263S

FOR USE ON DOOR #(S):

106	109	115	202	203	205B
328	330	404	405	502	505
507	510	512	520	522	

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	DBL CYL STORE W/DB	L9466L 06A	626	SCH
2	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING	626	
1	EA	OH STOP & HOLDER	100H SIZE AS REQ	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 341

FOR USE ON DOOR #(S):

105

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	PRIVACY W/DEADBOLT W/ OUTSIDE INDICATOR	L9440 06A 09-544 OS-OCC	626	SCH
1	EA	SURFACE CLOSER	4040XP REG	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 08 71 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install glass and glazing materials and accessories for both factory and field glazed assemblies specified.
   1. Refer to Section 08 60 00 - Roof Windows and Skylights.
   2. Refer to Section 08 80 00.1 - Animal Viewing Window Glazing.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Qualifications of Installers: Provide at least one person thoroughly trained and experienced in skills required, completely familiar with referenced standards and requirements of this work and to personally direct installation performed under this Section.

B. Applicable Standards For Glass and Glazing Work: Conform to the "Manual of Glazing" of the Flat Glass Marketing Association, requirements of Federal Specification DD-G-451c and Safety Standard 16 CFR 1201 of the U.S. Consumer Products Safety Commission.

C. Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, silk-screening and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002 1994.

1.05 APPLICABLE PUBLICATIONS

A. ANSI Z97.1-14: Safety Glazing Material Used in Building Safety Performance Specifications and Methods of Test.

B. ASTM C1036-21: Standard Specification for Flat Glass

C. ASTM C1048-12: Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

D. Code of Federal Regulations (CFR): 16 CFR 1201-10 Safety Standard for Architectural Glazing Materials.

E. International Building Code - Chapter 24: Glass and Glazing

1.06 DELIVERY, STORAGE AND HANDLING

A. Protection: Protect glass and glazing materials before, during, and after installation. Protect installed work and materials of other trades.

B. Storage and Protection: 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.

C. Replacements: In event of damage, immediately make repairs and replacements necessary and at Contractor's expense.

PART 2 - PRODUCTS

2.01 GLASS TYPES

A. No manufacturer logos are allowed on any glass, except as required by governing codes and standards. Provide certification to General Contractor that tempered, heat strengthened, annealed, laminated, etc. glass was used where required.

B. Annealed float glass shall comply with ASTM C1036, Type I, Class 1 (clear), Class 2 (tinted), Quality-Q3.

C. Heat-Strengthened float glass shall comply with ASTM C1048, Type I, Class 1 (clear), Class 2 (tinted), Quality Q3, Kind HS.

D. Tempered float glass shall comply with ASTM C1048, Type I, Class 1 (clear), Class 2 (tinted), Quality Q3, Kind FT.

E. Heat-treated glass with elastomeric coating complying with ASTM C1048, Condition C (other coated glass), Type I (transparent glass, flat), Quality Q3 (glazing select) and with other requirements as specified.

F. GANA/GTA 89-1-31, "Specification for Environmental Durability of Fully Tempered or Heat-Strengthened Spandrel Glass with Applied Opacifiers", and with other requirements as specified.

G. Provide type glass and thickness required and as follows:
   1. **Polycarbonate Plastic Glazing:** 3/8" (9.525mm) thick, 0A00-clear colorless, TUFFAK® AR Polycarbonate (Formerly Makrolon®) Abrasion and UV Resistant sheet or approved equal, as supplied by Boedeker Plastics, Inc., Tel.: 1-800-444-3485.

H. **Laminated Sloped and Overhead Glazing for Skylights:** 1-1/16" IGU comprised of a 1/4" tempered clear (non low-e), 3/8" air, and an inner pane of clear heat strengthened laminated glass with SentryGlas® Natural UV interlayer as supplied by Kuraray America, Inc., 800-635-3182. www.trosifol.com
   a. Provide 35/25 with 35% Visible Light Transmission and 0.25 Solar Heat Gain Coefficient (SHGC).

2.02 FLAT GLASS

A. Flat Glass:
   1. Shall comply with ASTM C1036-21 Standard Specification for Flat Glass, Type 1, Class 1, (clear) or Class 2 (tinted, heat-absorbing and light-reducing) and Quality q3.
   2. ASTM C 1048 Heat Treated Flat Glass, Kind HS or FT (remove ASTM Standard C 1048 if annealed glass), Condition A (un-coated), B (spandrel glass, one surface coated), or C (other coated glass).
      a. Heated Treated Flat Glass to be by horizontal (roller hearth) process with inherent rollerwave distortion parallel to the bottom edge of the glass as installed.
      b. Maximum peak-to-valley rollerwave 0.003" in the central area and 0.008" within 10.5' of the leading and trailing edge.
      c. For clear or low-iron glass 1/4" to 3/8" thick without ceramic frit or ink, maximum + or - 100mD (millidiopter) over 95% of the glass surface.
      d. Maximum bow and warp 1/32" per lineal foot.
      e. All tempered architectural safety glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.
      f. For all fully tempered glass, provide heat soak testing conforming to EN14179 which includes a 2 hour dwell at 290°C±10°C.

2.03 GLAZING ACCESSORIES

A. Provide glazing accessories required to complete glazing work that are compatible with various components of the glazing system(s), and subject to approval of Architect.

B. Glazing Sealants: Provide Tremco "Proglaze", Bostik "Chem-Calk 2000", Pecora "836", Dow Corning Silicon 795, or approved equal. Color to be selected by Architect from manufacturer's standard line.

C. Glazing Tapes: Provide Tremco "Pre-shimmed 440", Bostik "Chem Tape 60", Pecora "Shim-Seal", or approved equal. Color to be selected by Architect from manufacturer's standard line.

D. Setting Blocks: Neoprene or other resilient blocks of 70 to 90 Shore A durometer hardness, adhesive backed on one face only and tested for compatibility with specified glazing sealants.

E. Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness and tested for compatibility with specified glazing sealants.

F. Compressible Filler Rod: Closed-cell or waterproof jacketed foam of polyethylene, butyl rubber, neoprene, polyurethane or vinyl, tested for compatibility with specified glazing sealants, of 5 to 10 psi compression strength (25% deflection), recommended by sealant manufacturer for use in glazing channel to prevent sealant exudation from the channel.

PART 3 - EXECUTION

3.01 GLASS SIZES

A. Measure sizes for glass from actual frames, doors and windows. Contract requires glass to be set in place, and Contractor assumes responsibility for correct sizes. Use sizes shown on Drawings for estimating only as approximate dimensions.

3.02 GLAZING SURFACES

A. Glaze only dry surfaces, free from dust or ice. Clean dirty surfaces with cloth saturated with turpentine or mineral spirits before glazing. Remove loose dirt particles and mortar from recesses prior to installation of glass and glazing materials.

3.03 SETTING GLASS

A. Set glass to provide equal bearing for entire width of each pane. Contractor responsible for broken glass due to improper setting. Set using glazing stops furnished by door or fixed framing manufacturer unless otherwise shown or specified. Accurately set glass to fit frame, with all edges smooth. Sharp ragged edges are not acceptable. Cushion glass in fixed interior view windows with felt strips around entire perimeter.

3.04 CLEANING GLASS

A. Contractor shall employ services of a professional window washer at completion of all work to wash glass which has been installed under this contract, removing all stains.

B. Clean glass on both sides after painting operations are complete and dry. Do not use acid solutions or caustic soaps to clean glass.

C. Do not use razor blades to clean glass. Any scratches on the glass caused by the cleaning process will be cause for the removal and replacement of the damaged glass at the Contractor's expense.

3.05 SETTING AND CLEANING PLASTIC SHEET

A. Due to relatively high co-efficient of thermal expansion, make allowances in sizing of plastic sheets complying with manufacturer's instructions. Do not clean with abrasive or highly alkaline cleaners. Do not scrape with razor blades or sharp instruments.

END OF SECTION 08 80 00

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and the General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Glass products.
   2. Laminated glass.
   3. Insulating glass.
   4. Glazing sealants.
   5. Glazing tapes.
   6. Miscellaneous glazing materials.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Product test reports.

C. Preconstruction adhesion and compatibility test report.

D. Sample warranties.

1.7 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to 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. Warranty Period: 5 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Design Snow Loads: As indicated on Drawings.
   3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x degrees F.
2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

E. Acoustic Performance:
1. Exterior Glazing: 28 OITC.
2. Interior Glazing: 35 STC.

F. Bird Protection Coating: Exterior glazing shall incorporate a UV-reflected coating, for protection against bird collisions, tested and approved by the American Bird Conservancy's (ABC's) Standard, achieving an ABC effective rating of 70 percent minimum avoidance score. Bird protection coating shall be applied on the exterior pane No. 2 surface.

2.2 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least 1 component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with

"Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. AGC Glass Company North America, Inc.
      b. Cardinal Glass Industries.
      c. Guardian Glass; SunGuard.
      d. Pilkington North America.
      e. Vitro Architectural Glass.

B. Low-Iron Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and SHGC of not less than 0.87.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. AGC Glass Company North America, Inc.
      b. Guardian Glass; SunGuard.
      c. Pilkington North America.
      d. Vitro Architectural Glass.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) as indicated, Quality-Q3.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Eastman Chemical Company.
      b. Kuraray America, Inc.

   2. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions. Minimum thickness of each glass pane shall be 1/4-inch.
   3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements. Interlayer thickness shall be 1/8-inch minimum.
   4. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering product that may be incorporated into the Work include, but are not limited to, the following:
         1) Technoform.
         2) Thermix; a brand of Ensinger USA.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they 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: To match storefront color.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. May National Associates, Inc.; a subsidiary of Sika Corporation.
      c. Pecora Corporation.
      d. Sika Corporation.
      e. The Dow Chemical Company.
      f. Tremco Incorporated.

C. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Adfast.
      b. GE Construction Sealants; Momentive Performance Materials Inc.
      c. May National Associates, Inc.; a subsidiary of Sika Corporation.
      d. Pecora Corporation.
      e. Polymeric Systems, Inc.
      f. Sika Corporation.
      g. The Dow Chemical Company.

h. Tremco Incorporated.

D. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Bostik, Inc.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. May National Associates, Inc.; a subsidiary of Sika Corporation.
d. Pecora Corporation.
e. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
f. Polymeric Systems, Inc.
g. Sika Corporation.
h. The Dow Chemical Company.
i. Tremco Incorporated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:
1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

C. Spacers:
1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

D. Edge Blocks:
   1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
   2. Type recommended in writing by sealant or glass manufacturer.

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. 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 in accordance with requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in 1 continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

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. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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.
   1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE (As indicated on the Drawings)

A. Clear Glass Type: Fully tempered float glass.
   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

B. Low-Iron Glass Type: Fully tempered float glass.
   1. Basis-of-Design Product: Guardian, Low-Iron, Clear, Fully Tempered, Low-E, SunGuard SNX51/23.
   2. Minimum Thickness: 6 mm.
   3. Safety glazing required.

3.7 LAMINATED GLASS SCHEDULE (As indicated on the Drawings)

A. Monolithic Application of Laminated Glazing: Minimum overall thickness 14 mm.

B. Clear Laminated Glass Type: 2 plies of low-iron fully tempered float glass.
   1. Basis-of-Design Product: Guardian, Low-Iron, Clear, Fully Tempered, Low-E, SunGuard SNX51/23.
   2. Minimum Thickness of Each Glass Ply: 6 mm.
   3. Interlayer Thickness: 0.060-inch, SentryGlass.
   4. Safety glazing required.

3.8 INSULATING LAMINATED GLASS (BIRD PROTECTION) SCHEDULE (As indicated on the Drawings)

A. Low-E-Coated, Clear Insulating Laminated Glass Type:
   1. Basis-of-Design Product: Guardian, Low-Iron, Clear, Fully Tempered, Low-E, SunGuard SNX51/23.
   2. Overall Unit Thickness: 1-5/16-inch insulated Glazing Unit.
   3. Minimum Thickness of Outdoor Lite: 6 mm.
   4. Outdoor Lite: Clear fully tempered float glass.
   5. Interspace Size: 1/2-inch.
   6. Interspace Content: Argon.
   7. Indoor Lite: Clear laminated glass with 2 plies of fully tempered float glass.
      a. Minimum Thickness of Each Glass Ply: 6 mm.
      b. Interlayer Thickness: 0.060-inch, SentryGlass.
   8. Bird Protection UV Coating: Second surface.

9. Low-E Coating: Pyrolytic on third surface.
10. Safety glazing required.

END OF SECTION 08 80 00.1

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Provide specified painting and finishing of interior and exterior items.
   1. Provide painting of all new exposed steel and iron work, including primed metal surfaces. Paint exposed-to-view pre-finished metal surfaces of items, if required. Refer to drawings for existing metal to be painted.
   2. Provide touch-up of pre-finished items to match original finish.
   3. **Do not paint** waterproof coatings, water repellent coating, acoustical ceilings, toilet partitions, aluminum with factory applied finish, or pre-finished items, except as noted above.
   4. **Do not paint** over any code required metal labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates. Mask off the label before applying finish and remove masking after finish is dry.

B. Refer to the mechanical and electrical and plumbing drawings for extent of patching and repair work required for accommodation of renovation work. The color and finish of areas where demolition will be necessary and not specifically shown or noted on Drawings is required to match the existing conditions.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 DEFINITIONS

A. Term "paint", as used herein, includes enamels, paints, sealers, fillers, emulsions, varnishes, stains, and other coatings whether used as prime, intermediate, or finish coats.

1.05 QUALITY ASSURANCE

A. Qualifications of Painters: Use only qualified journeyman painters for mixing and application of paint. In acceptance or rejection of painting, no allowance made for lack of skill on part of painters.

B. Mockups - Interior and Exterior: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 SF.
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
      3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
      4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 PRODUCT HANDLING

A. Delivery: Deliver paint materials to job site in original unopened containers with labels intact and legible at time of use.

B. Protection:
   1. Store only approved materials at job site and store only in suitable and designated area restricted to storage of paint materials and related equipment.
   2. Ensure safe storage and use of paint materials and prompt and safe disposal of waste.
   3. Protect paint materials before, during, and after application and protect installed work and materials of other trades.

PART 2 - PRODUCTS

2.01 PAINT MATERIALS

A. Manufacturers: Provide paints, enamels, stains, varnishes, and admixtures of first line quality by Sherwin Williams or approved equal. Sherwin Williams products specified herein establish minimum quality standards. Approved equal products:
   1. Farrell-Calhoun
   2. PPG Paints
   3. Benjamin Moore

B. Compatibility:
   1. Paint materials and equipment to be compatible. Finish coats compatible with prime coats, prime coats compatible with surface to be coated, and tools and equipment compatible with coating applied.
   2. Thinners (when used): Use thinners recommended for that purpose by manufacturer of material thinned.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection: Carefully inspect installed work of other trades and verify work is complete to point where painting work may properly commence. Verify paint finishes may be applied in strict accordance with manufacturer's directions and requirements of these Specifications.

B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 PREPARATION OF SURFACES

A. Protection: Completely mask, remove, and adequately protect hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces not scheduled to receive paint.

B. Priming: Use primer recommended by manufacturer of coating system. Spot prime exposed nails and metals to be painted with emulsion paints.

C. Cleaning: Thoroughly clean surfaces receiving paint. Schedule cleaning and painting so dust and contaminants from cleaning process will not fall on wet, newly painted surfaces.

D. Gypsum Board: Treat and conceal joints, screw heads, and depressions in gypsum board surface in accordance with manufacturer's recommendations and instructions. Painted surfaces must be completely clean and continuously smooth. Treat internal and exterior corners and angles formed by intersection of wallboard surfaces and wallboard edges with joint reinforcements system in accordance with manufacturer's standard installation specifications where intersections and edges do not have metal trim. **All joints in gypsum board construction are to be taped and floated. This includes work above ceilings, at concealed places and anywhere else joints in gypsum board construction occur.** A slight egg-shell texture may be acceptable if approved by Architect prior to application. **Heavy "knockdown" texturing is not acceptable.**

E. Concrete and Concrete Block: Prepare surfaces in strict accordance with paint manufacturer's instructions and recommendations. Remove chalk, dust, dirt, grease, oils and substances which negatively effect paint adhesion. Perform appropriate tests to determine alkalinity and moisture content of surfaces. If surfaces are found sufficiently alkaline to cause blistering and burning of paint, correct condition before applying paint.

F. Wood: Clean wood surfaces free of dirt, oil, or foreign substances with scrapers, mineral spirits, and sandpaper. Sandpaper smooth those surfaces exposed to view, and then remove dust. Prime or seal wood requiring job painting immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of this wood. Scrape and clean small, dry seasoned knots, and apply thin coat of white shellac or manufacturer's recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty of plastic wood-filler. Sandpaper smooth when dried.

G. Primed Ferrous Metals: Clean ferrous metals free of dust, grease and grime. Sand smooth rust spots, mars and abrasions in surfaces. Touch-up shop-applied prime coats which have damage or bare areas. Wire-brush, solvent clean, and touch up with same primer as shop coat.

1. At decorative structural steel grind, smooth and fill all imperfections on surface to be completely smooth. Touch up shop primer as described in paint schedule.

H. Non-ferrous Metals: Clean off all oxidation, dust, grease and grime.

I. Galvanized Metal Surfaces: Clean free of oil and surface contaminates with acceptable non-petroleum based solvent. Touch up bare metal with zinc chromate primer.

3.03 WORKMANSHIP

A. Do not perform outside painting in extremely cold, frosty, or damp weather. Do not paint in dusty rooms. If required, sprinkle floors, to lay dust. Do not apply coats of paint on either wet or damp surfaces and in no case unless preceding coat is dry and hard.

B. Clean surfaces before priming. Remove dirt, oil, grease, rust, scale, and foreign matter. Clean with sandpaper, steel scraper, or wire brushes where necessary.

C. Specified coats are to cover completed painting and finishing work. Where color, stain, or undercoats show through final coat, install additional coats until uniform coverage is obtained.

D. Vary tints of undercoats slightly for identification of succeeding coats. Ample time of drying required to secure best possible results.

E. Coats specified are in addition to shop or mill priming required under other Sections of these specifications.

F. All cabinet devices that require finish painting are to be painted with doors in the open position and shall be allowed to dry for a minimum of 24 hours in the open position. DO NOT PAINT DOORS CLOSED AND TRIM AFTER DRYING.

1. Cabinets that require finish painting include, but are not limited to, wall and ceiling access doors, fire extinguisher/hose/valve cabinets, electrical panel boxes, etc.

3.04 MOISTURE CONTROL

A. Give back side of interior wood trim in contact with masonry units one application of water repellent preservative.

3.05 PAINT SCHEDULE

A. Finish surfaces as follows:

	SURFACE	TREATMENT
1a.	**Exterior Steel / Ferrous Metals:**	1st Coat - SW Pro-Cryl® Universal Water Based Primer, B66-310 Series (Touch up only on primed surfaces) 2nd & 3rd Coats - SW B66W01151 - Pro Industrial DTM Acrylic Semi-Gloss
1b.	**Exterior Steel | Shade Structure Poles:**	1st Coat - SW Kem® 400 Primer on cleaned steel, 1.0-1.25 DFT for optimum corrosion protection. 2nd & 3rd Coats (if required) - SW F75BC17 - SHER-KEM® High Gloss Metal Finishing Enamel DTM Semi-Gloss Black.
2.	**Interior Ferrous Metals:**	1st Coat - SW Pro-Cryl Universal Water Based Primer, B66-310 Series (Touch up only on primed surfaces) 2nd & 3rd Coats - SW ProMar 200 Alkyd Eg-Shel B33 or S/G B34 as selected by Architect.
3.	**Interior Aluminum:**	1st Coat - SW Pro-Cryl Universal Water Based Primer, B66-310 Series (Touch up only on primed surfaces) 2nd & 3rd Coats - SW ProMar 200 Alkyd Eg-Shel B33 or S/G B34 as selected by Architect.
4.	**Exterior Aluminum:**	1st & 2nd Coats - SW A-100 Exterior Latex Flat A6 or Satin A82 as selected by Architect.
5.	**Galvanized Metals:**	1st Coat: SW B66W00310 - Pro Industrial Pro-Cryl® Universal Acrylic Primer Off White 2nd & 3rd Coats: SW B66W01151 Pro Industrial DTM Acrylic Semi-Gloss Extra White.
6.	**Interior CMU - Painted:**	Prime Coats - SW PrepRite Block Filler, B25W25 as required to eliminate all pinholes. 2nd & 3rd Coats - SW ProMar 200 Latex Eg-Shel B20-2200 or S/G B31-2200 Enamel as selected by Architect.

7.	**Interior CMU - Glazecoat:**	Fill CMU walls with Three (3) Coats of Sherwin Williams Heavy Duty Block Filler, B42W46. SW Water Based Epoxy, B70-200 Series with Gloss Hardener B60V15
8.	**Architectural Woodwork: Painted**	1st Coat - SW Prep Rite Wall and Wood Primer B49W2 2nd & 3rd Coats - SW ProMar 200 Interior Alkyd S/G, B34
9.	**Elastomeric Coating (Exterior CMU):**	Prime Coat - Provide manufacturer's recommended primer, undercoat or block filler if required. Thorolastic 100% acrylic with 300% elongation by BASF
10.	**Interior - Extreme Abuse Gypsum Board - Painted:**	1st Coat: SW B51W00620 - PrepRite® ProBlock® Interior/Exterior Latex Primer/Sealer White. 2nd & 3rd Coats: SW B31W02651 - ProMar™ 200 Zero VOC Interior Latex Semi-Gloss Extra White.

ITEM #10 NOTE: Painting contractor to verify that paint formula is compatible with board. Paint manufacturer to review and provide letter or certification.

11.	**Interior - Abuse Resistant Gypsum Board - Painted:**	1st Coat - Sherwin Williams DTM Bonding Primer Pro Industrial™ DTM Acrylic Coating B66A50. 2nd & 3rd Coats - SW Pro Industrial™ DTM Acrylic Coating, Color as selected by Architect.
36.	**Interior Fiber-Cement Siding Factory-Primed - Painted:**	1st Coat - Sherwin Williams DTM Bonding Primer Pro Industrial™ DTM Acrylic Coating B66A50. 2nd & 3rd Coats - SW Pro Industrial™ DTM Acrylic Coating. Color as selected by Architect.
12.	**Exterior Fiber-Cement Siding Primed and Un-Primed: Painted**	1st & 2nd Coats - SW Duration® Exterior Latex Coating. **Caulk at butt joints.**
13.	**PVC Pipe:**	Clean with non-petroleum based product (no solvents) and lightly sand 1st & 2nd & Coats - Bond-Plex® Waterbased Acrylic Coating
14.	**Interior CMU - Wet Areas - : Showers**	Prime Coat: SW Kem Cati-Coat HS Epoxy Filler/Sealer [Alternate: Cement-Plex® 875] 2nd & 3rd Coats - SW Macropoxy® 646-100 Fast and Cure Epoxy in a Semi-Gloss Finish color as selected by Architect.

3.06 PAINTING OF MECHANICAL AND ELECTRICAL WORK

A. Painting of pipe and duct insulation and un-coated ferrous metal in inaccessible pipe and duct chases, in plumbing chases, and in spaces above ceiling is not required.

B. Metal Work in Mechanical Room (finish as follows):
   1. Clean pre-finished equipment and touch up with enamel to match manufacturer's final coat.
   2. Clean exposed pipe, exposed conduit and electric outlet boxes, hangers and brackets, valve handles, and miscellaneous pipe line devices and give two coats of medium gray enamel.
   3. Clean prime painted or unfinished items of manufactured mechanical and electrical equipment, then prime and finish with two coats of enamel to match other finished items of equipment.
   4. Finish remaining exposed metal items with two coats of light grey enamel.

C. Paint exposed interior metal work, including ferrous and non-ferrous piping, for heating ventilating, plumbing and electrical equipment, electric cabinets, ventilating grilles, metal access panels. Give exposed metal items one coat of enamel undercoater and one coat of enamel in addition to priming coat.

D. Give pipe and duct insulation exposed to view one coat glue size and two coats enamel.

E. Paint all mechanical, electrical and plumbing items that are visible through registers, grilles and diffusers with Flat Black-Out paint.

3.07 PROTECTION, CLEAN UP, AND TOUCH-UP

A. Protect all work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint drops and smears from hardware, glass and other surfaces and items.

C. Before final inspection, touch-up or refinish painted surfaces which have become damaged or discolored.
   1. Perform touch-up work in a manner to produce solid even color and finish texture to match surrounding color and finish texture.
   2. Areas that receive touch-up work and do not match surrounding color or finish texture will be refinished at Contractors expense.

3.08 REPAINTING AND REFINISHING

A. Thoroughly clean existing surfaces in present building to be repainted and give one or more new coats of same type of paint originally used. Clean existing natural finish surfaces, sand and give new coat of varnish or finish originally used. Treat patched and repaired surfaces as new surfaces. For bidding purposes figure two coats of paint as average requirement. Scrape surfaces to be repainted, sand by hand or machine, and prepare to receive new coats.

B. Paint rooms and areas in existing building noted on drawings to paint existing surfaces or required by Finish Schedule.

C. Paint all rooms and areas in existing building where cutting and patching occurs. Paint after cutting, patching, and remodeling in rooms and areas is completed. Where cutting and patching is required on only one wall or surface, paint the entire room or area. Where cutting or patching occurs along a corridor wall, paint entire corridor wall from corner to corner or between termination lines designated by Architect.

D. Patch all cracks in concrete masonry and mortar that are more than 1/16 inch with knife grade elastomeric caulking.

END OF SECTION 09 91 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:
   1. Concrete.
   2. Concrete masonry unit (CMU).

B. Interior mural painting shall be provided by Owner. This Section is provided for reference only.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 RELATED SECTIONS

A. Section 09 91 13 “Painting.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Behr Paint Company; Behr Process Corporation.
   2. Benjamin Moore & Co.
   3. California Paints.
   4. Conco Paints.
   5. Coronado Paint; Benjamin Moore & Co.
   6. Diamond Vogel Paints.
   7. Dulux Canada; a licensed product of PPG Architectural Coatings.
   8. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
   9. Duron, Inc.
   10. Frazee Paint; Comex Group.
   11. Glidden Professional.
   12. Kelly-Moore Paint Company Inc.

13. Kwal Paint; Comex Group.
14. M.A.B. Paints.
15. McCormick Paints.
16. Parker Paint; Comex Group.
17. PPG Paints.
18. Pratt & Lambert.
19. Rodda Paint Co.
20. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
21. Sherwin-Williams Company (The).
22. United Gilsonite Laboratories (UGL).
23. Valspar Corporation (The).
24. Vista Paint Corporation.
25. Zinsser; Rust-Oleum Corporation.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Mural Artist from manufacturer's full range.

2.3 MURAL ARTISTS

A. Contractor shall coordinate construction of walls and related materials, finish and texture to receive murals, with selected mural artist, to ensure proper installation and substrate compatibility with selected paint system, for proper application of paints, the type of paints, and durability and longevity of the painted mural.

B. Contractor shall coordinate the construction schedule of the walls to receive the murals, so that the mural artist will be able to start the murals at the appropriate time frame for the paint application in order to achieve the best possible installation for the longevity and durability of the mural painting Work.

C. Proposed paint system for the murals shall be safe, not toxic, and shall not represent any health hazard to the animals. Proposed mural paint system shall be durable and sustain periodic cleaning and maintenance procedures.

D. The mural artist is to submit proposed paint system MSDS test data, chemical composition of paints, application procedures, test data for durability and maintenance performance as tested by a licensed laboratory testing agency, for review and approval by the Architect, prior to mural artist selection or mural application.

E. Mural artist companies acceptable to perform the required Work include, but are not limited to the following, providing their Work and proposed painting system are in compliance with the Project requirements as indicated in the Contract Documents and as directed and approved by the Owner:
   1. Walls of the Wildlife: www.wallsofthewildlife.com.
   2. Zoo Enrichment Lab: www.zooenrichmentlab.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 INTERIOR MURAL PAINTING SCHEDULE

A. Concrete Masonry Unit (CMU) Substrates, Nontraffic Surfaces:
   1. Loxon Painting System by Sherwin-Williams Co.:
      a. Prime Coat: Loxon Concrete and Masonry Primer/Sealer.
      b. Intermediate Coat: Loxon XP.
      c. Topcoat: Diamond clear coat sealer.

B. Concrete Masonry Unit (CMU) Substrates, Nontraffic Surfaces:
   1. Epoxy Paint System:
      a. Prime Coat: PPG Amerlock 200.
      b. Intermediate Coat: SW Duration, exterior.
      c. Topcoat Sealer: SW “Sher-Clear” Sealer.

3.5 PHOTO REFERENCE

A. Photographs of representative natural features are included in the following pages of the Photo Reference for artistic guidelines to the types of features, details, colors, etc., to be used in the creation of the hand-painted murals in the animal dayrooms shown on the AH-Series Drawings.

END OF SECTION 09 91 23.1

Capybaras and Squirrel Monkeys are native to Central and South America, and are typically found in dense tropical rainforests and other wooded areas near bodies of water such as river, lakes, ponds, marshes, or swamps.

Hand-painted murals as indicated and located per the Contract Documents for these species shall represent the South American rainforest. Particular attention should be made to the dense and diverse plant life, vegetation and mosses, rock formations, and dynamic water volumes to give depth of view of the exhibit. The paints and products used for the creation of the mural shall follow all specification requirements and withstand wet conditions in addition to periodic cleaning and washing with mild detergents.

Refer to additional reference photos provided on the following page for examples of trees, palms, and other plantings found within this region.

Trees


Brazil Nut Tree (Bertholletia excelsa)


Kapok Tree (Ceiba pentandra)


Mahogany Tree (Swietenia macrophylla)

Palms


Açaí Palm (Euterpe oleracea)


Mauritia Palm (Mauritia flexuosa)

Other Plants


Ferns (Pteridophyta)


Heliconias (Heliconiaceae)


Bromeliads (Bromeliaceae)

The Giant Anteater primarily inhabits the Grasslands (Savannas) of Central and South America, often in open areas where they can easily spot ant and termite mounds.

Hand-painted murals as indicated and located per the Contract Documents for these species shall represent the Central/South American Grasslands. Particular attention should be made to the dense grasses and vast open plains interrupted only by low hills to give depth of view of the exhibit. The paints and products used for the creation of the mural shall follow all specification requirements and withstand wet conditions in addition to periodic cleaning and washing with mild detergents.

Refer to additional reference photos provided on the following page for examples of grasses found within this region.

Grasses


Andropogon lateralis


Nassella tenuissima


Pampas grass (Cortaderia selloana)

Ring-tailed lemurs are native to the spiny forests in the south/southwestern regions of the Island of Madagascar. Their natural habitat includes dry deciduous forests and arid/open scrub lands. Geological variation ranges from limestone plateaus, sandy coastal plains, mountains, to volcanic formations.

Hand-painted murals as indicated per the Contract Documents for these species shall represent the Island of Madagascar dry deciduous forest. Particular attention should be made to the diverse plant life and unique endemic species found within the region to give depth of view of the exhibit. The paints and products used for the creation of the mural shall follow the specification requirements and withstand wet conditions in addition to periodic cleaning and washing with mild detergents.

Refer to reference photos provided on the following page for more examples of trees and other plantings found within this region. These plants and trees have adapted to survive the harsh conditions of Madagascar's dry deciduous forests, where they endure prolonged periods of drought followed by seasonal rains.

Trees


Baobabs (Adansonia)


Bismarck Palm Bismarckia nobilis


Tapia (Uapaca bojeri)


Octopus trees (Didierea madagascariensis Baill.)


Pachypodium

Shrubs and Other Plants


Angraecum sesquipedale (Darwin's Orchid)


Alluaudia procera
(Madagascar Ocotillo)


Catharanthus roseus (Madagascar Periwinkle)

In their native habitat, the Aldabra Giant Tortoise are found on Aldabra Island, one of the Seychelles Islands off Africa northeast of Madagascar in the Indian Ocean. Aldabra Island is a coral atoll boardered by jagged limestone rock formations and small beaches, and encloses a large mangrove bordered lagoon. These Aldabra Tortoises are terrestrial and inhabit a wide range of habitats on the island, including scrub forests, mangrove swamp, and coastal beaches and dunes.

Hand-painted murals as indicated per the Contract Documents for these species shall represent the Aldabra Island mangrove swamp and coastal beach. Particular attention should be given to the dynamic rock formations and diverse, unique (often endemic) plant life found within the region to give depth of view of the exhibit. The paints and products used for the creation of the mural shall follow the specification requirements and withstand wet conditions in addition to periodic cleaning and washing with mild detergents.

Refer to reference photos provided on the following page for more examples of plant life found within this region. As Aldabra Island is well isolated and fairly large, there is almost no human influence and therefore the island has evolved a pristine and unusual ecosystem with numerous unique species of plants- 273 total species including up to 42 endemic species.

Plants & Shrubs


Allophylus aldabricus


Aloe aldabrensis


Bruguiera gymnorhiza


Avicennia marina


Rhizophora mucronata


Ceriops tagal


Pemphis acidula (Shrubby Coral Pemphis)


Tropicbird orchid (Angraecum seychellarum)

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide UV cured elastomeric waterproofing wall coating system, on masonry, block, brick, concrete, stone, fiber cement material, plastic, metal, mastics, painted surfaces, plaster, or other approved substrate by manufacturer and shown on the drawings and described herein.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:
   1. Waterproofing Manufacturer must show evidence that the specified membrane has been manufactured by the same organization or direct affiliate for fifteen (15) years.
   2. Waterproofing Manufacturer shall have available an in-house technical staff to assist the contractor, when necessary, in application of the products and final inspection of the assembly.

B. In-Progress Inspection: During the application process, the coating membrane manufacturer or his representative shall inspect the work involved.

C. Installer's Qualifications: The Contractor shall demonstrate qualifications to perform the work of this Section by submitting the following documentation:
   1. Certification or license by the waterproofing membrane manufacturer as an authorized applicator of the product the installer intends to use.

D. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary waterproofing manufacturer.

E. Final Inspection
   1. Manufacturer's representative shall provide a comprehensive final inspection after completion of the coating system. All application errors must be addressed and final punch list completed prior to the issuance of the warranty.

F. Mockups: Prepare one mockup of coating system with chosen color to verify preliminary selections made under sample submittals.
   1. Architect will select exterior wall surface of at least ten square feet to represent surfaces and conditions for application of elastomeric coating.
   2. If Architect/Engineer determines mockup does not comply with requirements, modify mockup or construct new mockup until mockup is approved.
   3. Final approval of color selections will be based on approved mockup.

G. Pre-Installation Meeting:
   1. Conduct meeting at Project site.
   2. Review requirements for waterproofing including:
      a. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays
      b. Site use, access, staging, and set-up location limitations
      c. Surface preparation and substrate condition and pretreatment.
      d. Installation procedures.
      e. Special details.
      f. Minimum curing period.
      g. Testing and inspection requirements.
      h. Site protection measures.
   3. Contractor's site foreman, waterproofing manufacturer's technical representative, waterproofing Installer, Owner's Agent, and Architect shall attend.

1.05 COMPLIANCE

A. Work for this project shall be conducted in accordance with all applicable Local, State and Federal laws and regulations with the most restrictive law and regulations applying.

B. Permits, inspections and appropriate certificates as required by work under this contract shall be obtained by and paid for by the Contractor.

C. The Contractor shall comply with all ordinances regarding dust, debris and noise.

D. The Contractor shall familiarize himself with all aspects of job conditions prior to submitting his bid for the project.

E. The Contractor shall protect all adjacent surfaces, fixtures and equipment to prevent damage in any form.

F. Any adjacent surface, coating system, fixture or equipment damaged in this sequence of work shall be repaired or replaced at no cost to the owner by the Contractor to its original condition.

G. All waterproofing system components shall meet current VOC regulations as established by the State in which they are being installed; and stating total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, etc.).

1.06 TESTING

A. Upon completion of the coating membrane work, the manufacturer's representative and the contractor will calculate the coverage rate and subsequent dry film thickness of the applied coating material to ensure that the minimal requirements of this technical specification have been met. If actual dry film thickness needs to be measured, then the dry film thickness may be measured with a Tooke Gage or cutting out of a physical sample and measurement under a graded reticule microscope.

B. If minimum dry film thickness requirements have not been met by the contractor, then additional coating membrane material must be applied by the contractor at his cost to fulfill the specification requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original containers with seals unbroken, labeled with waterproofing manufacturer's name, product brand name and type, date of manufacture, lot number, and directions for storing and mixing with other components.

B. Keep materials dry and do not allow materials to be exposed to moisture during transportation, storage, handling, and installation. Reject and remove from Site new materials which exhibit evidence of moisture during application, or have been exposed to moisture.

C. Store materials in original, undamaged containers in clean, dry, protected location on raised platforms with weather-protective coverings, within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight. Waterproofing manufacturer's standard packaging and covering is not considered adequate weather protection. Use "breathable" type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.

D. Store all materials at temperatures between 35°F and 86°F.

E. Remove and replace materials that cannot be applied within stated shelf life.

1.07 PROJECT CONDITIONS

A. All surfaces to be coated shall be clean, sound and properly prepared for the coating application.

B. Verify existing dimensions and details prior to installation of materials. Notify Architect/Engineer of conditions found to be different than those indicated in Contract Documents. Architect/Engineer will review situation and inform Contractor and Installer of changes.

C. Observe Owner's limitations and restrictions for site use and accessibility.

D. Application of the coating membrane shall not commence nor proceed during conditions outside of the general ambient parameters for application (between 40°F and 95°F), or during pending inclement weather. Inclement weather must be anticipated such that the applied elastomeric membrane is adequately dried and cured to prevent wash-off in driving rain.

E. All terminations for elastomeric waterproofing wall coating system shall be as per Architect/Engineer's drawings and details.

F. Install materials in strict accordance with safety requirements required by waterproofing manufacturer, Material Safety Data Sheets, and local, state, and federal rules and regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products from the following manufacturer:

Sika Corporation
201 Polito Avenue
Lyndhurst, NJ 07071 USA
Customer Service: 800-933-7452

2.02 MATERIALS

A. High-build, water-based, high build, 100 percent acrylic, waterproof coating.
1. Acceptable Product: Thorocoat®-400 by Sika USA.

B. Thorocoat® HB 400 Smooth:
1. Density, ASTM D1475: 11.4 to 12.4 lbs per gal (1.37 to 1.49 kg/L).
2. Solids Content, ASTM D5201:
   a. By Weight: 53.4 - 56.4 percent.
   b. By Volume: 37.0 - 39.0 percent.
3. Viscosity, ASTM D562: 105 to 120 KU.

4. VOC Content, ASTM D3960: 0.83 lbs per gal (100 g/L), less water and exempt solvents.

C. Performance Requirements: MasterProtect HB 400 Smooth:
1. Resistance to Wind-Driven Rain, Federal Specification ASTM D 6904: Meets requirement. No water penetration.
2. Accelerated Weathering, ASTM G152, 5,000 hours: Passes.
3. Visual Color Change, ASTM D1729, 5,000 hours: Passes.
4. Chalking, ASTM D4214, 5,000 hours: Passes.
5. Freeze/Thaw Resistance, DOT Methods A and B, 50 cycles: Passes.
6. Water-Vapor Permeance, ASTM D1653: 13 perms.
7. Moisture Resistance, Federal Specification TT-C-555B: Meets requirement. No blistering, loss of adhesion, or discoloration.
8. Salt Spray (Fog) Resistance, ASTM B117, 300 hours: Passes.
9. Carbon-Dioxide Diffusion, PR EN 1062-6:
   a. R (equivalent air-layer thickness): 1,318 feet (402 m).
   b. Sc (equivalent concrete thickness): 39 inches (100 cm).
10. Flexibility, ASTM D1737, 1-inch mandrel: No cracking.
11. Dirt Pick-Up, ASTM D3719, after 6 months exposure: 92 percent. Passes.
12. Sand Abrasion Resistance, ASTM D968, Method A, at 3,000 L: Passes.
13. Impact Resistance, ASTM D2794, at 30 in-lbs: Passes.
14. Fungus Resistance, ASTM D3273: No growth. Meets requirement.
15. Mildew Resistance, Federal Specification TT-P-29 (Federal Standard 141, Method 6152 and 6271.1):
   a. Aspergillus Oryzae, 7 days: No growth.
   b. Aspergillus Niger, 21 days: No growth.
16. Surface Burning Characteristics, ASTM E84:
   a. Flame Spread: 1.
   b. Smoke: 4.
   c. Fuel Contribution: 7
17. Flash point, Greater than 200 degrees F (93 degrees C) ASTM D 56 Tag Closed Tester

D. Approximate Coverage Rate: 75 to 100 sq ft per gal (1.84 to 2.46 m2/L).

E. Wet Film Thickness (WFT):
1. Smooth: 16 to 22 mils (406 to 559 microns).
2. Fine: 16 to 22 mils (406 to 559 microns).
3. Coarse: 16 to 22 mils (406 to 559 microns).

F. Dry Film Thickness (DFT):
1. Smooth: 6 to 8 mils (152 to 203 microns).
2. Fine: 8 to 11 mils (203 to 279 microns).
3. Coarse: 8 to 11 mils (203 to 279 microns).

G. Color to be selected by architect.

H. Texture: Smooth

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Protection: Protect adjacent Work areas and finish surfaces from damage during coating application.

B. Prepare surfaces in accordance with manufacturer's instructions.

C. Ensure that substrate is sound, clean, dry, and free of dust, dirt, oils, grease, laitance, efflorescence, mildew, fungus, biological residues, and other contaminants that could prevent proper adhesion.

D. Clean surface to achieve texture similar to medium-grit sandpaper.

E. Repair holes and spalled and damaged concrete with repair materials approved by coating manufacturer.

F. Remove protruding concrete accessories and smooth out irregularities.

G. When chemical cleaners are used, neutralize compounds and fully rinse surface with clean water. Allow surface to dry before proceeding.

H. Remove blisters or delaminated areas and sand edges to smooth rough areas and provide transition to existing paint areas.

I. Check adhesion of existing paint in accordance with ASTM D3359, measuring adhesion by Tape Method A.

J. Concrete Surfaces:
   1. Cure concrete a minimum of 28 days before application.
   2. Remove laitance, bond-inhibiting contaminants, form-release agents, and sealers.
   3. Remove form tie wires and repair holes, small voids, and spalls using appropriate repair product approved by coating manufacturer.
   4. Abrasive-blast slick, dense concrete surfaces or use primer approved by coating manufacturer. Test surface for proper adhesion.

K. Brick and Concrete Masonry Unit (CMU) Surfaces:
   1. Ensure CMUs are laid true and fully cured to full load-bearing capacity.
   2. Remove mortar splatter and excess mortar.
   3. Repoint or fill voids with appropriate patching product approved by coating manufacturer.
   4. Ensure mortar joints are sound and free of voids and cracks.
   5. Apply base coat approved by coating manufacturer to new CMUs.
      a. Acrylic Copolymer Block Filler: Sika Thorocoat®-749 Block Filler to prime and fill porous masonry before application of Sika Thorocoat® high-build acrylic wall coatings.

L. Existing Acrylic Coating Surfaces:
   1. Sand or grind edges of existing coating to ensure adhesion and smooth transition of new material. Sand edges of area to feather-edge.
   2. Wash down and allow to completely dry.
   3. Prime chalky surfaces with primer approved by coating manufacturer.

M. Crack Preparation and Pretreatment:
   1. Treat cracks larger than 1/32 inch and up to 1/16 inch with brush-grade acrylic crack filler approved by coating manufacturer.
   2. Treat cracks larger than 1/16 by 1/16 inch but less than 1/4 by 1/4 inch with knife-grade acrylic crack filler approved by coating manufacturer.
   3. Treat moving cracks larger than 1/4 by 1/4 inch with internally plasticized polyurethane sealant approved by coating manufacturer.
   4. Apply test application of crack repair materials in inconspicuous location to ensure compatibility and aesthetic approval.

3.02 MIXING

A. Mix coating in accordance with manufacturer's instructions to ensure uniform color and aggregate disbursement and to minimize air entrapment.

B. In multi-pail applications, mix contents of each new pail into partially used pail to ensure color consistency and smooth transitions from pail to pail.

3.03 APPLICATION

A. Apply coating in accordance with manufacturer's instructions.

B. Apply coating as a 2-coat system.

C. Maintain proper uniform wet-film thickness during application to ensure performance characteristics desired.

D. Apply coating to achieve pinhole-free, consistent film build on coated surfaces.

3.04 PROTECTION

A. Protect applied coating from damage during construction.

END OF SECTION 09 96 53

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PART 1 - GENERAL

1.01 SUMMARY

A. General: Provide all labor, materials, equipment, tools and services, necessary to complete the fabrication and installation of the Work, as indicated by the Drawings.

B. Coordination: Assign a Project Manager prior to beginning Work for coordination with the Owner for complete understanding and execution of the project requirements throughout the entire project. This includes, but is not limited to project meetings, submission review, fabrication and installation.

C. Provide 911 address signage on outside of building as required by local municipality and NFPA if required:
   1. NFPA 1 Fire Code 2018: New and existing buildings shall have approved address numbers placed in a position to be plainly legible and visible from the street or road fronting the property. Address numbers shall be a minimum of 4 inches (100 mm) high with a minimum stroke width of 1/2 inches (13 mm).

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Shop Drawings: List sign styles, lettering, materials, thicknesses, locations and dimensions of each interior sign.

D. Selection Samples: One complete set of color chips representing manufacturer's full range of available colors.

E. Verification Samples: Two full size samples representing each type, style, material, thickness, and color specified, including method of attachment.

1.04 QUALITY ASSURANCE

A. Use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, and thoroughly familiar with requirements of this work.

B. Regulatory Requirements: Comply with requirements of ICC/ANSI A117.1 and ADAAG.

1.05 PRODUCT HANDLING

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

PART 2 - PRODUCTS

2.01 BUILDING SIGNAGE

A. Contractor to allow the sum as stipulated in Section 01 21 00 - Allowances, in the Base Bid for purchase, taxes, delivery to site and installation of all exterior and interior building signage to be selected by Architect. Allow minimum 6-8 weeks for production and installation of typical identification signage prior to local Certificate of Occupancy.

B. All signage to be purchased under the stated allowance will comply with the 2017 ICC ANSI A117.1 Accessible and Usable Buildings and Facilities ADA Standards for size, location, color, type face and braille.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install signage in accordance with manufacturer's recommendations.

END OF SECTION 10 14 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Standard-Duty Wire Mesh Partitions and Transfer Cages (M1, M2, M3, and M4).
      a. M1 and M2 Partitions are interior cages for cabybara and squirrel monkey holding. Partition systems and cages (M1 and M2) are by Corners Limited.
      b. M3 and M4 partitions are exterior cages for cabybara and squirrel monkey holding. Partition systems (M3 and M4) are by Corners Limited.
   2. Heavy-Duty Wire Mesh Partitions (M5):
      a. M5 partitions are interior cages for anteater holding cells. Partitions M5 are by A thru Z Consulting.

B. Section Also Includes:
   1. Wire mesh ceiling.
   2. “Cagework” keeper doors and accessories.
   3. Aluminum solid infill panels.
   4. Insultated panel shift doors and solid polyethylene shift doors.
   5. Service doors.
   6. Steel shelving, perches, and accessories.
   7. Structural framing system.
   8. Concrete perimeter grade beams.
   9. Concrete foundations.

C. Work Under this Section Includes:
   1. Site visits.
   2. Measuring existing conditions prior to fabrication.
   3. Fabrication of all items specified and/or shown on Drawings, including required accessories for a complete and fully functional installation of cages, wire mesh partitions, solid infill panels, wire mesh ceilings, transfer cages, keeper doors, shift doors, animal perches, structural framing, and foundations.
   4. Delivery of required caging and complete installation.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Wire mesh partitions and ceilings.
   2. “Cagework” doors and accessories.
   3. Shift doors, shelving, and accessories.
   4. Vertical panels.

5. Structural columns and ceiling support systems.

B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
2. Indicate clearances required for operation of service windows, doors, and gates.

C. Samples: Manufacturer's standard color sheets, showing full range of available colors for units with factory-applied color finishes.

D. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: Welding certificates.

B. Delegated design engineer qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.
2. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
a. AWS D1.1/D1.1M (steel).
b. AWS D1.3/D1.3M (steel).
c. AWS D1.2/D1.2M (aluminum).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Furnish welded wire mesh partitions and aluminum cagework (M1, M2, M3, and M4) by Corners Limited aluminum cagework products. https://www.cornerslimited.com. See Drawings for locations.

B. Basis of Design: Furnish (M5) wire mesh welded partitions by A Thru Z Consulting and Distributing, Inc. https://athruzcad.com. Or, Contractor’s Option by Nets Unlimited Inc. https://netsunlimited.com. See Drawings for locations.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design wire mesh units.

B. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
   2. Total load of 200 lbf applied uniformly over each panel.
   3. Concentrated load and total load need not be assumed to act concurrently.

C. Structural performance of interior and exterior welded wire mesh partitions in aluminum wire and/or structural member fabrications shall match or exceed the heavy-duty performance of the steel members indicated within this Section.

D. Seismic Performance: Wire mesh units to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.3 STANDARD-DUTY INTERIOR WIRE MESH PARTITIONS (M1 AND M2)

A. Cage Panels:
   1. Configuration: Floor to ceiling installation.
   2. Mesh for M1 Partitions: 12.5-gage minimum, GAW wire welded into mesh per Drawings.
      a. Finish: Silver.
   3. Solid aluminum panels for M2 partitions, as shown on Drawings.
   4. Vertical and Horizontal Panel Framing: 1-inch square anodized aluminum tubing. Weld wire mesh to frame.
   5. 1/8-inch anodized aluminum angle to seal off all connections to walls and ceilings.

B. Swinging Keeper Doors: Fabricated from same mesh as partitions, with framing fabricated of tubing as standard with manufacturer and shown on Drawings.
   1. Stainless-steel piano hinges on all keeper doors.
   2. Stainless-steel hardware.
   3. Padlock Lug: Mortised into door framing and enclosed with steel cover.
   4. Padlocks by Owner.

C. Shift Doors: Insulated solid aluminum sheet panel doors for capybara and squirrel monkey cages at exterior CMU wall locations, as shown on Drawings.

D. Shelving: Steel perches, as shown on Drawings.

2.4 STANDARD DUTY EXTERIOR WIRE MESH PARTITIONS (M3 AND M4)

A. Cage Panels:
   1. Configuration: Floor to elevation shown on Drawings.
   2. Mesh for M3 Partitions and Overhead Covers: 12.5-gage minimum, GAW wire welded into 1-inch-squre mesh.
      a. Finish: Silver
   3. Solid aluminum panels for M4 partitions, as shown on Drawings.
   4. Vertical and Horizontal Panel Framing: 1-inch square anodized aluminum tubing. Weld wire mesh to frame.
   5. 1/8-inch anodized aluminum angle to seal off all connections to walls and ceiling.

B. Swinging Keeper Doors: Fabricated from same mesh as partitions, with framing fabricated of tubing as standard with manufacturer and as shown on Drawings.
   1. Stainless-steel piano hinges on all keeper doors.
   2. Stainless-steel hardware.
   3. Padlock Lug: Mortised into door framing and enclosed with steel cover.
   4. Padlocks by Owner.

C. Shift Doors and Shelving: As shown on Drawings.

D. Structural System:
   1. Vertical Posts: 4-inch by 4-inch by 1/4-inch-thick wall aluminum posts.
   2. Base Plates: 12 inches by 12 inches by 1-inch-thick aluminum plates.
   3. Horizontal Beams: 3 inches by 6 inches by 1/4-inch-thick wall aluminum tubing.
   4. Finish: Powder coated aluminum. Color as selected by Architect.

E. Foundations:
   1. 6-inch-wide by 36-inch-deep perimeter grade beam to also function as animal dig barrier.
   2. Perimeter and center column foundations, size and depth as indicated in the Delegated Design Drawings and approved shop drawings.
   3. Concrete for foundations shall be in accordance with Section 03 30 00 “Cast-In-Place Concrete.”

2.5 HEAVY-DUTY WIRE MESH PARTITIONS (M5)

A. Configuration: Floor to ceiling installation.

B. Mesh: 0.25-inch-diameter, intermediate-crimp and/or double-weave steel wire woven into 2-inch diamond mesh or maximum opening size as shown on Architectural Drawings.

C. Vertical and Horizonal Panel Framing: 2- by 2- by 1/8-inch steel tubing as required; with holes for 3/8-inch-diameter bolts not more than 12 inches o.c.

D. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated of tubing as standard with manufacturer and as shown on Drawings.
   1. Stainless-steel piano hinges on all keeper doors.
   2. Stainless-steel hardware.
   3. Padlock Lug: Mortised into door framing and enclosed with steel cover.
   4. Padlocks by Owner.

E. Heavy-Weight, Guillotine and Horizontal Sliding Shift Doors: Fabricated from same mesh as partitions, and 1-inch-thick polypropylene face panels, and steel framing as shown on Drawings.

2.6 ACCESSORIES

A. Accessories as standard with manufacturer, as required, and as indicated on the Drawings for a complete and functional installation.

1. Wall Clips: Manufacturer’s standard, cold-rolled steel sheet; allowing up to 1 inch of adjustment.
2. Neoprene Tape: Manufacturer's standard material separation tape for contact separation of aluminum and steel members.

2.7 FINISH

A. Finish: Hot-dip galvanized and/or powder-coated finish as applicable and as indicated on the Drawings.
   1. Color: As indicated on Drawings.

2.8 MATERIALS

A. Steel Wire: ASTM A510/A510M.

B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.

D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.

E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.

F. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

H. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
   1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

I. Power-Driven Fasteners: ICC-ES AC70.

J. Seismic Bracing: Angles with legs not less than 1-1/4 inches wide, formed from 0.040-inch-thick, metallic-coated steel sheet; with bolted connections and 1/4-inch-diameter bolts.

K. Shop Primers: Provide primers that comply with Section 09 91 00 "Exterior Painting" and Section 09 91 23.1 "Interior Painting."

L. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

M. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.

N. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.9 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
   1. Fabricate wire mesh items to be readily disassembled.
   2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
   1. Mesh: Weld mesh to framing.
   2. Framing: Fabricate framing with mortise-and-tenon corner construction.
      a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
      b. Fabricate 3- and 4-way intersections using intersection posts.
      c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
   3. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
   4. Doors: Align bottom of door with bottom of adjacent panels.
      a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
   5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

C. Wire Mesh Ceilings: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
   1. Mesh: Weld mesh to framing.
   2. Framing: Fabricate framing with welded corner construction.
      a. Provide stiffeners as indicated or, if not indicated, as required by panel span and as recommended by wire mesh ceiling manufacturer. Weld stiffeners to framing.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

E. Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.
   1. Color and Gloss: As indicated on the Drawings.

F. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils.
   1. Color and Gloss: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRE MESH PARTITIONS

A. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
   1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on shop drawings.

B. Anchor wire mesh partitions to floor with 3/8-inch-diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
   1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on shop drawings.

C. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
   1. For concrete and solid masonry anchorage, use expansion anchors.
   2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

D. Secure top capping bars to top framing channels with 1/4-inch-diameter, "U" bolts spaced not more than 28 inches o.c.

E. Provide line posts at locations indicated or, if not indicated, as follows:
1. On each side of sliding-door openings.
2. For partitions that are 7 to 9 feet high, spaced at 15 to 20 feet o.c.
3. For partitions that are 10 to 12 feet high, located between every other panel.
4. For partitions that are more than 12 feet high, located between each panel.

F. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

G. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

H. Install doors complete with door hardware.

I. Install service windows complete with window hardware.

J. Weld or bolt sheet metal bases to wire mesh partitions and doors where indicated.

K. Bolt accessories to wire mesh partition framing.

3.2 INSTALLATION OF WIRE MESH CEILINGS

A. Anchor wall support angle to walls at 12 inches o.c. and as follows:
1. For concrete and solid masonry anchorage, use expansion anchors.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board assemblies, use lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

B. Attach wire mesh ceiling panels to wall support angles with bolts at 12 inches o.c.

C. Attach wire mesh ceiling panels to wire mesh partitions with slotted angles bolted to sides of ceiling panels and to top of partitions at 12 inches o.c.

D. Attach wire mesh ceiling panels to intermediate supports as recommended by manufacturer.

E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

3.3 REPAIR

A. Repair Painting:
   1. Wire brush and clean rust spots, welds, and abraded areas immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
      a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
   2. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas are included in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.4 ADJUSTING

A. Adjust doors, gates, and service windows to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 10 22 13

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install metal accessories called for in Toilet Accessory Schedule.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Samples: Submit a sample of each component illustrating color and finish.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.04 REFERENCES

A. 2021 Arkansas Fire Prevention Code (IBC 2021), Chapter 11 - Accessibility.

B. BABIES Act, or Bathrooms Accessible In Every Situation Act (2016) requiring changing tables in all publicly accessible federal buildings as determined by the GSA.

C. 2017 ICC A117.1 - Accessible and Usable Buildings and Facilities.

D. 2010 ADA Standards for Accessible Design.

E. ADA Accessibility Guidelines for Buildings and Facilities, July 23, 2004 – Provisions for Children.

F. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

G. ASTM A167-99 (Re-approved 2004) - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

H. ASTM A269/A269M-2015 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

I. ASTM A794/A794M-2018 - Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16 % Maximum to 0.25 % Maximum), Cold-Rolled.

J. ASTM B456-2003 - Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.05 QUALITY ASSURANCE

A. Use personnel skilled in work required, completely familiar with manufacturers' recommended methods of installation, and thoroughly familiar with requirements of this work.

1.06 PRODUCT HANDLING

A. Protection: Protect toilet and bath accessories before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

PART 2 - PRODUCTS

2.01 METAL TOILET ACCESSORIES

A. Manufacturers and Accessory Numbers are listed in Toilet Accessory Schedule. Manufacturers who may furnish products for review by Architect are:
1. American Specialties
2. Bobrick
3. Bradley
4. comfortdesigns
5. Delta Faucet
6. McKinney
7. Approved Equal

2.02 MATERIALS

A. Stainless Steel: AISI Type 302/304, with “Brushed” finish, 0.034-inch (22-gage) minimum thickness.

B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 527, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

2.03 FASTENERS

A. Provide screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.04 PLUMBING PIPE WRAP

A. At all exposed lavatory piping, provide TRUEBRO Lav Guard® 2, Fast Fit Undersink Piping Covers as manufactured by IPS Corporation, 202 Industrial Park Lane, Collierville, TN 38017, 800-340-5969 or approved equal.
   1. Use at all sinks or lavatories that do not have removable apron.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Coordinate with other trades to ensure proper and adequate provision in framing and wall finish for installation of selected accessories.

B. Prior to installation, inspect location of accessories and verify that necessary provisions have been made. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' recommendations, anchoring components firmly in place.

END OF SECTION 10 28 13

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Firefighting devices consist of hand-portable fire extinguishers and accessories.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

A. NFPA 10 - Standard for Portable Fire Extinguishers

B. ADA Accessibility Guidelines

C. IBC/IFC Tables 906.3(1) and 906.3(2) for determining extinguisher rating, fire classification, hazard classification, and travel distance.

D. UBC Standard 7-5 (ASTM E-814-83) - Fire-rated cabinet option for combustible and non-combustible walls.

1.05 QUALITY ASSURANCE

A. Provide fire extinguishers, cabinets, and accessories by a single manufacturer.

1.06 PRODUCT HANDLING

A. Protection: Protect firefighting devices before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. **Basis of Design:** Larsen's Manufacturing Co., 7421 Commerce Ln NE, Minneapolis, MN 55432, (763) 571-1181 or (800)527-7367.
   2. Potter Roemer, 17451 Hurley St, City of Industry, CA 91744 Phone: (800) 366-3473 E-mail: info@potterroemer.com
   3. JL Industries, Activar Construction Products Group, 800-554-6077. Email: sales@activarcpg.com

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B. Abbreviations:
   WHE-1 Wall Hung Extinguisher (with clip or bracket)

2.02 FIRE EXTINGUISHERS

A. **Type 1:** Provide multi-purpose dry chemical type, Model MP-10 with UL Rating 4A-80B:C for Class A, B and C fires manufactured by Larsen's®, or approved equal.

2.03 EXTINGUISHER BRACKETS

A. Provide Model No. 817 MP10 wall brackets with baked enamel finish as manufactured by Larsen's® or approved equal.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Coordination: Coordinate with other trades to ensure proper and adequate provision in framing and wall covering for installation of recessed cabinets.

B. Inspection:
   1. Prior to installation, inspect cabinet recesses, and verify that necessary provisions have been made.
   2. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install the items of this Section in strict accordance with the original design, approved shop drawings, and requirements of agencies having jurisdiction, as approved by the Architect, anchoring all components firmly into position.

3.03 SERVICE

A. Determine approximate completion date of Work. Inspect, charge, and tag fire extinguishers at date not more than ten days before or less than one day before actual completion date of the Work.

END OF SECTION 10 44 00

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PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide other miscellaneous specialties specified.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

A. Furnish at least one person, present at all times, thoroughly familiar with installation requirements of each item, to personally supervise installation.

1.05 PRODUCT HANDLING

A. Protection: Protect miscellaneous specialty items before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make repairs and replacements at Contractor's expense.

PART 2 - PRODUCTS

2.01 DECORATIVE PEBBLE PEA GRAVEL

A. Provide 1/4"-1/2" Round Rock Pea Gravel (multi-colored) as supplied by Landscape Shoppe, 5000 Salem Dallas Hwy NW, Salem, OR 97304. Tel.: (503) 391-2833 Email: info@landscapeshoppe.com . Approved equal suppliers:
   1. The Good Earth Garden Center, (501) 868-4666, 15601 Cantrell Road Little Rock, AR 72223.
   2. Bedrock Landscaping Materials, (303) 432-7222, 5401 W 52nd Ave, Denver, CO 80212.

3. Timber Ridge Wood Products, (616) 785-5182, 4335 Abrigador Trail NE, Comstock Park, MI 49321. Website: www.timberridgewoodproducts.com .

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Prior to installation, verify items may be installed in accordance with manufacturers' recommendations.

B. Notify Architect of conditions that would adversely affect installation.

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

3.02 INSTALLATION

A. Install miscellaneous specialties in strict accordance with manufacturers' current recommendations and instructions.

3.03 ADJUSTMENT AND CLEANING

A. Verify that trim is in place and adjust components.

B. Remove labels from equipment and remove packing materials from job site.

END OF SECTION 10 80 00

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Provide custom-fabricated food service equipment indicated on the contract drawings.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Shop Drawings: Show dimensions, method of assembly, installation and conditions relating to adjoining work which requires cutting or close fitting, reinforcement, anchorage, and other work required for complete installation.

1.04 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. ASME International (ASME):
A112.18.1-11……Plumbing Fixture Fittings

C. ASTM International (ASTM):
A554-16……Welded Stainless Steel Mechanical Tubing
A666-15……Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

D. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06……Metal Finishes Manual

E. NSF International/American National Standards Institute (NSF/ANSI):
2-10……Food Equipment

F. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines, 20081

G. Comply with all applicable laws, statues, building codes, regulations of state, local, public authorities and comply with the following:
1. National Sanitation Foundation.
2. National Fire Protection Association.
3. Underwriter's Laboratories, Inc.
4. Factory Mutual.
5. Building Official and Code Administrators.
6. National Electrical Code.
7. American Gas Association Labs.
8. Occupational Safety and Health Act.
9. National Electrical Manufactures Association.
10. Americans with Disabilities Act.
11. American National Standards Institute.

1.04 QUALITY ASSURANCE

A. Submit evidence to the owner, architect and consultant of qualifications listed below:
1. Successful completion of projects of comparable size and scope.
2. Maintain a staff experienced in the installation of Kitchen Equipment and the preparation of professional drawings and brochures.

1.05 JOB CONDITIONS

A. Before ordering Kitchen Equipment and starting work verify measurements at job site. Be responsible for fitting Kitchen Equipment into space provided. No extra charge or compensation will be allowed for minimal difference between dimensions indicated and actual field dimensions.

B. Verify that Kitchen Equipment will fit through openings provided.

C. Prior to ordering Kitchen Equipment verify all mechanical and electrical utilities available at the project site and coordinate.

1.06 WARRANTIES

A. Warranties for parts and labor in writing for all new Kitchen Equipment for a period of one year from date of acceptance.

B. Refrigeration system compressors shall be warranted for an additional four years by the manufacturer.

C. Provide at no cost to owner, refrigeration service including freon, mileage, parts and labor to all refrigeration equipment within 24 hours of notification for one year from date of acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS | EQUIPMENT

A. United States standard gauge 18-8, type 302, not over .012% maximum carbon stainless steel with a number 4 finish.

B. **Worktables with Flat Top and Stainless Steel Base with Undershelf - Spec-Master® Series:** Provide as supplied by Eagle Group, constructed of 14 gauge 300 series stainless steel, with 1-1/2" roll on front and rear, and sides turned down 90°. Tel.: (302) 653-3000. Refer to drawings for sizes.

C. **Coved Corner One-Compartment Sink - Spec-Master® FN Series:** Provide as supplied by Eagle Group, constructed of 14 gauge 300 Series, 18-8 stainless steel throughout. Sink bowls coved with a full 5/8" radius, and shall have a 14" water level. Drainboards, when required, shall be “V” creased for positive drainage. Legs to be 1-5/8" O.D., stainless steel, with stainless steel crossbracing and adjustable steel bullet feet. Tel.: (302) 653-3000. Refer to drawings for sizes.

PART 3 - EXECUTION

3.01 EXAMINATION OF SITE

A. REFER TO DIVISION 1 for General Requirements
   1. Before submitting prices or beginning work, thoroughly examine the contract documents.
   2. No claim for extra compensation will be recognized if difficulties are encountered which examination of site conditions and contract documents prior to executing contract would have revealed.
   3. Food Service Equipment Contractor is responsible for verification of and coordination with all dimensions, quantities, finishes, field dimensions and roughing of utilities for the equipment to be installed. Food Service Equipment Contractor is responsible for verifying there are no conflicts between the documents published by the Architect, Engineers and Consultant. Should the Food Service Equipment Contractor fail to verify and coordinate as stated, he shall without cost to owner, make any necessary modifications to the equipment to complete proper installation to the satisfaction of the Architect and Consultant.
   4. Inspect all equipment described as "Owners" or "Existing" that is to be reused to verify condition, serviceability and utility requirements.

3.02 DELIVERY, STORAGE AND HANDLING

A. Receive food service equipment in factory fabricated containers, inspect for damage and hold in warehouse.

B. Hold equipment in original containers in a location to provide adequate protection without interfering with other construction operations.

C. Handle equipment to avoid damage to components, enclosures and finish. Do not install damaged equipment.

C. Provide all necessary equipment and manpower to receive and handle equipment on job site with deliveries based on project schedule.

3.03 PREPARATION

A. Various items are specified herein by model number, brand name, trade name or name of manufacturer. It is the intent of this specification that the exact product be provided as specified. This requirement is not intended to restrict competition and consideration will be given to other brands that are equal or better in every respect. However, no substitutes or alternates will be acceptable if not submitted in writing prior to the bid.

B. The decision as to acceptance or rejection of any alternate proposed shall be that of the owner and/or architect or his consultant, and their decision shall be final.

C. If equivalent products are submitted and accepted, Food Service Equipment Contractor shall be responsible for any costs arising from mechanical changes due to relocation of connections or utility requirements other than those indicated on mechanical drawings and specifications.

D. Upon acceptance of bid and consummation of contract, Food Service Equipment Contractor shall designate, by letter to the architect, one individual of his organization who shall thereafter act as his representative in all negotiations and instructions given his representative shall be valid and binding on this contractor.

3.04 CONSTRUCTION / INSTALLATION

A. Install equipment in accordance with manufacturer's printed instructions, all applicable codes and approved drawings for other contractors to make final electrical, gas, water, waste, ventilation and all utility connections.

B. Install units plumb, square, level and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.

C. Remove all packing material/straps and install all accessories in preparation for start-up and check-out.

D. Verify all utility connections have been properly completed.

E. Manage schedule so as to have all equipment connected and tested not less than five days prior to Owner's scheduled takeover date.

3.05 FIELD QUALITY CONTROL

A. General: Comply with requirements of Section 01 45 00.

B. After all utility connections have been made by other contractors, The Food Service Equipment Contractor shall conduct final test in presence of Architect, Consultant, Owner and/or their designate to ensure that all equipment is ready for operation as required.

C. Each item of mechanically or electrically operated equipment shall be started, demonstrated and checked for proper operation by manufacturer's representative. Owner's representatives will be instructed in the proper operation and maintenance of all equipment.

D. Food Service Equipment Contractor's Representative will be on project site during working hours the first day of complete owner operation to assist as required.

E. Food Service Equipment Contractor shall provide letter stating the accomplishment of 3.05-C above. Include name of Food Service Equipment Contractor's representative who supervised instruction/demonstration as well as statement that owner's operations personnel thoroughly understand the proper operation and maintenance of all equipment and so signify by signing. Final Inspection of work shall not be contemplated prior to receipt of this documentation by architect/consultant.

3.06 ADJUSTING, CLEANING AND PROTECTION OF WORK

A. Adjusting:
   1. Start-up, calibrate, and verify proper operation of all equipment no later than 72 hours prior to demonstration or receiving food product.

B. Cleaning:
   1. Food Service Equipment Contractor shall remove form project site all trash created by equipment installation on a daily basis.
   2. Prior to final inspection and owner operation, Food Service Equipment Contractor shall remove all protective coatings, thoroughly clean and service all equipment.

3.07 EXISTING ITEMS

1. In the event that existing equipment is designated on the equipment schedule and/or Specifications, the FSEC shall ensure that any and all such equipment is removed from the original location, cleaned, repaired/modified as required for proper operation, stored and re-installed as dictated by the project schedule.
2. It is the responsibility of the Food Service Equipment Contractor to review all existing equipment prior to submitting a bid to verify equipment condition and utility requirements.
3. Existing equipment will be warranted serviceable for a period of 90 days from substantial project completion.

END OF SECTION 11 40 00

PART 1 - GENERAL

1.01 SUMMARY

A. The Tensioned Fabric Manufacturer (hereafter referred to as "TF Manufacturer") shall be responsible for the design, engineering, fabrication, supply and installation of the work specified herein. The intent of this specification is to have single source responsibility for the above functions.

B. Performance Requirements: The TF Manufacturer shall be responsible for the configuration, fabrication and erection of the tension membrane structure. All materials provided shall be new and unused.

C. Erection of the complete system shall be the responsibility of the same firm designing and manufacturing the fabric structure.

D. The fabric structure may be a frame supporting system. The fabric shall have low elongation characteristics under tension and shall assume a tight fit.

E. Main steel structure as shown in the drawings and described in this specification is supplied by General Contractor. General Contractor will be responsible for sufficient structure attachment points. Anchoring for the structure shall be the responsibility of the General Contractor.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Data required: Manufacturer product data, including specifications and installation instructions for each component. Include laboratory test reports and other data, where applicable.

D. Engineering drawings: 11" x 17", dimensioned drawings for the TF Manufacturer signed and sealed by a licensed civil or structural engineer. Include plan view, elevations, details, sections, connections and anchorage/footings.

E. Structural calculations: Signed and sealed by a registered structural or civil engineer specializing in TF Manufacturer design and engineering.

1.04 REFERENCES

A. AWS D1.1 - American Welding Society Structural Welding Code

B. AWS D1.2 - American Welding Society Structural Welding Code, Aluminum

C. NFPA 701 - National Fire Protection Association Fire Test for Flame Propagation of Textiles and Films

D. ASCE 7 - American Society of Civil Engineers, Minimum Design Loads for Buildings and other structures

E. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

1.05 QUALITY ASSURANCE

A. Acceptable Manufacturer:
   1. Lawrence Fabric and Metal Structures, 3509 Tree Court Industrial Blvd, St. Louis, MO 63122, Phone: (636) 861-0100, Attn: Tim Koehler, Customer Solutions, timkoehler@lawrencefabric.com www.lawrencefabric.com

B. TF Manufacturer must provide proof of the following certifications:
   1. Have been in continuous operation as a professional fabric TF Manufacturer for a minimum of ten (10) years prior to this contract.
   2. Welder Qualifications: The personnel manufacturing the metal frames must be certified welders.
   3. Provide written Welding Procedure Specifications.
   4. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where project is located and who is experienced in providing engineering services of installing Tensioned Fabric Structures similar to those indicated for this project and with a record of successful in service performance.
   5. Ongoing qualified safety program with historical data available on request.
   6. OSHA Fall Protection Training.
   7. Proper safety training certification for lifts, booms and other equipment.
   8. Job site installation crew must include one CPR trained member on the job site at all times of the installation.
   9. The installation crews must have a copy of the company's Code of Safety practices at the job site during times of installation.
   10. Hold daily Safety Tail Gate Meetings before start of installation work.
   11. When forklifts are used at the job site, the operator must be Fork Lift Operation Trained.
   12. The TF Manufacturer must provide proof of full-time Quality Assurance manager.

13. The TF Manufacturer must provide proof of $1-Million Occurrence, $2-Million Aggregate (also a $5-Mil Umbrella over those limits) general liability insurance coverage.
14. The TF Manufacturer must provide proof of workers compensation insurance coverage.
15. TF Manufacturer is required to be a current member of the professional trade association, Fabric Structure Association.
16. Have a Master Fabric Craftsmen (MFC) on staff and involved in the project.
17. Vehicle insurance certification.

1.06 DESIGN

A. The structural design shall comply with applicable codes and regulations.

B. Design Engineering documentation of complete TF Manufacturer will meet all applicable codes.

C. The structure shall be designed in accordance with the IBC Building Code with the design wind speed to be 90 MPH minimum.

D. ENGINEERING:
1. Based on the structural calculations as defined in this section, prepare structural design drawings defining the complete structure, precise interface geometry determination, reaction loads imposed on anchoring loads, connect details, interfaces and seam layouts.
2. Structural calculations for the fabric structure shall include:
   a. Large deflection numerical shape generation will ensure a stable and uniformly stressed, with the internal prestress forces, and is suitable to resist all applied loads.
   b. Large deflection finite element method structural analysis of the membrane system under all applicable wind, seismic and snow loads.
   c. Finite element method structural analysis of the support frame system.
   d. Connection design including both weld and ancillary member sizing.
   e. Biaxial Fabric test specification, interpretation and fabric compensation determination.
   f. Accurate generation of the two-dimensional compensated fabric templates.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings for Tension Fabric covering.

B. Life Safety: All fabric structures shall be designed so no life safety issue is created in the event of a loss of the fabric. The structural support members shall not rely on the fabric for structural stability.

1.08 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Deliver material to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer. Store materials in accordance with the manufacturer's instructions, in a clean, dry, well ventilated area, above ground on blocking and do not allow materials to become wet, stained or dirty.

B. Handling: Handle materials so as to protect materials, coatings and finishes during transportation and installation to prevent damage or staining. Handle fabric in accordance with manufacturer's instructions. Use care in handling of fabric to avoid damage to fabric material and coating. Do not damage, crush or kink cables where folds occur.

1.09 WARRANTY

A. Warrant frame materials and workmanship against defect for a period of one year from the date of substantial completion of the work.

B. Warrant fabric materials and workmanship against defects for a period of twelve years, on a prorated basis, from the date of substantial completion of the work and/or offer the same warranty offered by the fabric mill that manufactured or supplied the fabric.

PART 2 - PRODUCTS

2.01 ENVIRONMENTALLY PREFERABLE PRODUCTS

A. Provide environmentally preferable products (EPP) to the greatest extent possible.

B. Provide products and material that promote stewardship of the earth's resources, promote good indoor environmental quality and promote efficiencies in operational performance.

C. EPP's include products that have low VOC content, high recycled content, and are manufactured, fabricated or extracted within 500 miles of the construction site.

2.02 MATERIALS

A. APPROVED ARCHITECUTURAL FABRIC MEMBRANE MATERIALS
   1. Gale Pacific - Commercial 95 340 FR

B. STRUCTURAL STEEL FRAMING
   1. Structural frame shall be fabricated from structural steel using standard shapes. The steel shall be minimum ASTM A36 for standard profiles and A500 Grade B for structural tubes.

2. The fabrication of the steel shall be in accordance with guidelines set forth in the AISC steel design manual and the AWS code of structural welding. All welds shall be in accordance with manufacturers design and performed prior to shipping. No welding shall be performed in the field unless authorized in writing by the Owner or Owner's representative.
3. The structural members shall be fabricated in as large segments as possible to minimize field joints.
4. All segments of the assembly will be welded or stamped with the appropriate part number in a manner that will still be visible after paint is applied where applicable.
5. Grind all corners and sharp edges.
6. Steel will require proper preparation and primer before application of the finish paint.
7. The steel shall be painted with primer and two-part epoxy urethane finish or powder coated.

C. ALUMINUM FRAMING
1. Aluminum shall conform to alloy 6061-T6
2. All components will be welded or stamped with the appropriate part number in a manner that will still be visible after paint (if desired) is applied.
3. The aluminum will require proper preparation and primer before application of the finish paint (if desired).
4. Aluminum will be painted with an etching primer and two-part epoxy urethane finish (if desired) or powder coated.

D. BOLTS AND RELATED FASTENERS
1. Fasteners and hardware accessories shall be of types and sizes best suited for the purpose as recommended by the engineer on record.
2. Fasteners used on main structural members shall be hot-dipped galvanized high-strength bolts including nuts and washers and confirming with ASTM A325 or A490 as applicable. All other fasteners shall be adequately sized and treated for corrosion protection.
3. Concrete anchor bolts shall conform to A307 and be hot-dipped Galvanized.

2.03 FABRICATION

A. In accordance with the approved manufacturer's standard procedures and to match approved samples.

B. Fabric panels shall be manufactured with RF Welded/sewn seams.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the conditions under which this work is to be performed and correct unsatisfactory conditions.

B. Correct unsatisfactory conditions before proceeding with installation.

3.02 ERECTION

A. TF Manufacturer will prepare a full CAD drawing with assembly procedure guide prior to installation.

B. Comply with the TF Manufacturer recommendations, the approved shop drawings and the applicable Code requirements.

C. Weather Conditions: Proceed with installation of the fabric and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers recommendations. The TF Manufacturer structure shall not be installed when wind conditions are deemed in excess of manufacturer's determination of safe wind speed erection conditions. It shall be the manufacturer's sole discretion to determine acceptable and safe wind condition for installation.

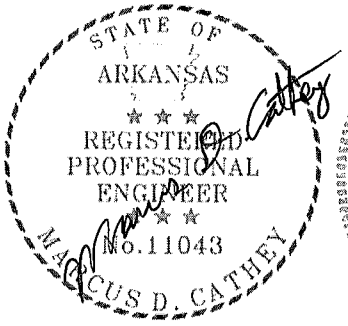
E. Fabric: Prior to the start of installation; check all surfaces of framing members and other rigid construction elements to be in contact with fabric to ensure that all edges are smooth and well rounded. Remove any potential causes for snagging or tearing of the fabric. Properly install all connections and provide all materials and equipment required for the erection and stressing of the fabric. Unroll the fabric in such a manner as to avoid snagging or dragging the fabric over sharp objects during installation. Adequate fabric prestress shall be confirmed by the fabric structure manufacturer and the appearance of the fabric membrane roof shall be smooth and wrinkle free. Creasing or folding the fabric around sharp corners shall be avoided at all times.

F. After installation, restore marred or abraded surfaces to original condition using same paint or coating as factory-applied finishes, when the results are acceptable to the Architect, otherwise replace damaged equipment.

END OF SECTION 13 31 23

The Engineer of Record for Divisions 22 and 23 of the Specifications for the Little Rock Zoo, Entry Habitats Renovation Project, Little Rock, Arkansas (P & P Job No. 24-027) is:

12/20/24
Date



PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for complete plumbing system.

1.02 RELATED SECTIONS

A. Section 22 10 05 – Plumbing Piping.

B. Section 22 30 00 – Plumbing Equipment.

C. Section 22 40 00 – Plumbing Fixtures.

1.03 SITE INSPECTION

A. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

1.04 DRAWINGS

A. Mechanical drawings show general arrangement of piping ductwork, equipment, etc. Follow closely as actual building construction and work of other trades will permit.

B. Consider architectural and structural drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over mechanical drawings.

C. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories required to meet the conditions.

D. Record difference between mechanical work as installed and as shown in Contract Documents on a set of prints of mechanical drawings to be furnished by Architect. Return these prints to Architect at completion of project. These will be labeled "Contractor Revised Drawings".

1.05 SUBSTITUTIONS

A. The naming of specified items on the drawings or in the specifications is intended to establish a level of quality and performance. Substitution requests may be submitted at the time of shop drawing submittal. Review of substituted equipment or material prior to the Bid Date will not be considered unless otherwise specified.

B. Substitution shall be submitted as specified in Division 01.

1.06 CODE REQUIREMENTS, FEES & PERMITS

A. Perform work in accordance with applicable provisions of state and local Plumbing Code, gas ordinances and adoptions thereof. Provide materials and labor necessary to comply with rules, regulations and ordinances.

B. In case of differences between building codes, state laws, local ordinances, utility company regulations and Contract Documents, the most stringent shall govern. Promptly notify Architect in writing of such differences.

1.07 CONTRACTOR REVISED DRAWINGS

A. The contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job.

B. Exact location of all underground utility service entrances and their connections to utility mains, well heads, loop piping and all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances.

C. Upon completion of the work and prior to final payment, the contractor shall furnish to the Architect, one set of "contractor revised" prints, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.

D. Contractor shall include all addendum items and field change order information on the revised drawings. Revise all schedules shown on the drawings to reflect the actual model numbers, capacities and electrical characteristics of substituted equipment.

1.08 COORDINATION OF WORK

A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to Architect. Should conditions arise where certain changes would be advisable, secure Architect's approval of these changes before proceeding with work.

B. Coordinate work of various trades in installing inter-related work. Before installation of mechanical items, make proper provisions to avoid interferences in a manner approved by Architect. Changes required in work specified in Division 22 caused by neglect to do so shall be made at no cost to Owner.

C. Provide inserts and supports required by Division 22 unless otherwise noted. Furnish sleeves, inserts, supports and equipment that are an integral part of other divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location of installation of items above shall be borne by Division 22.

D. Be responsible for required digging, cutting and patching incident to work of this

Division and make required repairs afterward to satisfaction of Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns or trusses.

1. Each Section of this Division shall bear expense of cutting, patching, repairing and replacing of work of other Sections required because of its fault, error, tardiness or because of damage done by it.
2. Cutting, patching, repairing and replacing pavements, sidewalks, roads and curbs to permit installation of work of this Division is responsibility of Section installing work.

E. Adjust locations of pipes, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.

1. Make offsets, transitions, and changes in direction of pipes, as required to maintain proper headroom and pitch of sloping lines whether or not indicated on Drawings.

F. Slots and openings through floors, walls, ceilings and roofs shall be provided by other Divisions in their respective materials. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.09 EXCAVATION AND TRENCHING FOR PIPING

A. Excavate to the depths indicated on the Drawings or as otherwise specified. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulated therein shall be removed by pumping or by other approved method. Do sheeting and shoring as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of trench may be tunneled if the pipe can be safety and properly installed and backfill can be properly tamped in such tunnel sections.

B. Trench Excavation: Bottom of trench for tile or concrete pipe shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered, excavate to a minimum overdepth of 4" below trench depths indicated on the drawings or specified. Overdepths in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered, such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

C. Depth of Cover: Trenches shall be of depth that will provide a minimum depth of cover of three feet for water, sanitary and storm sewer and two feet for gas piping from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

1.10 BACKFILLING OF TRENCHES

A. Trenches shall not be backfilled until required pressure and other tests have been performed, inspection of utility and Code officials have been accomplished, and

until the utilities systems as installed conform to requirements of drawings and specifications.

B. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones over 2-1/2-inch maximum dimension, deposited in 6-inch layers and compacted to 95% of the maximum laboratory density determined in accordance with ASTM D-698, Moisture-Density Relation of Soils. Tests for maximum density will be made with expense borne by contractor. If fills fail to meet the specified densities, the contractor shall remove and recompact the fill until specified densities are achieved.

C. Tests for Displacement of Sewers: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the contractor at his expense.

1.11 GENERAL PIPING INSTALLATION

A. Furnish and install a complete system of piping. The piping drawings are diagrammatic and indicate the general location and connections. If the size of any piping is not clearly evident, obtain instructions from the Architect before proceeding with the work. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the contractor from responsibility for the proper erection of systems of piping in every respect suitable for the work intended. Piping systems that are not to be installed complete shall be so noted.

B. Erection: Piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing. Remove all burrs and cutting slag by reaming or other cleaning methods. Changes in direction shall be made with fittings, except that bendings of pipe will be permitted, providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles, or other malformation will not be acceptable. Piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access manholes or other access openings. Piping shall be installed to ensure noiseless circulation.

C. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified:

Type of Piping Fluid Conveyed	System Component	Length for 1" Fall	Direction of Fall
Sewer, Sanitary	Main or Branch	4 feet	Direction of flow
Domestic Water	Main or branch	40 feet	Back to mains

Sanitary and storm drainage piping 4 inches in diameter and larger may be pitched with one (1) inch fall for eight (8) foot lengths.

D. Protection: Open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs or rags, wood, cotton, concrete, waste or similar materials must not be used in plugging.

E. Installation of Underground Pipe: Bottom of trench shall be shaped to give

substantially uniform circumferential support to lower third of each pipe. Pipe shall be laid true to line and grade in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, interior of pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drain shall be kept in pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing has set and pipe shall not be laid when condition of trench or weather is unsuitable for such work.

F. Cleaning and Flushing: Contractor shall take every precaution to remove dirt, grease, and all other foreign matter from each length of piping before making connections in the field. After each section of piping is installed, it shall be flushed with clean water except where specified otherwise.

G. Pipe Sizes: If the size of any piping is not clearly evident in the drawings, the contractor shall request instructions from the Architect as to the proper sizing. Any changes resulting from the contractor's failure to request clarification shall be at his expense.

1.12 THERMAL AND MOISTURE PROTECTION

A. Install flashing, counterflashing and caulk or seal all penetrations in exterior walls or floors as required to prevent exterior moisture from entering building.

1.13 EQUIPMENT AND MATERIALS

A. Product Approvals:
   1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
   2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in specification.

B. Use domestic made pipe, pipe fittings and motors on project.

C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connection and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents.

D. Follow Manufacturer's directions in delivery, storage, protection and installation of equipment and materials.
   1. Promptly notify Architect in writing of conflicts between requirements of Contract Documents and manufacturer's directions and obtain Architect's written instructions before proceeding with work. Bear expenses arising from correcting deficiencies of work that do not comply with Manufacturer's directions or such written instructions from Architect.

E. Deliver equipment and material to site and tightly cover to protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.14 REVIEW OF MATERIALS AND EQUIPMENT

A. Furnish complete catalog data for manufactured items of equipment to be used in Work to Architect for review within 30 days after award of Contract.

B. Submit six (6) copies of data in 3-ring binders with tab indices in same order and name as they appear in specification.
   1. State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions and other pertinent information. Pertinent information shall include as a minimum those items as scheduled on the drawings. Arrange submittal information to reflect these categories scheduled on the drawings.
   2. Provide an index of tab numbers at the front of each binder. List the specification number and category included under each tab as described in the specifications and as scheduled on the drawings.
   3. Provide cover sheet for each tab section. List each piece of equipment by name, model number and supplier.
   4. Underline applicable data and indicate model being supplied on each submittal sheet.

C. If data is not submitted as specified or submittal is not complete, it will be returned without review.

D. Catalog data or shop drawings for equipment which are noted as being reviewed by the Architect, shall not supersede Contract Documents.

E. Review comments of Architect shall not relieve this Division from responsibility for deviations from Contract Documents unless Architect's attention has been called to such deviations in writing at the time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

F. Check work described in catalog data with Contract Documents for deviations and errors.

1.15 GUARANTEE

A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or in the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

B. The Contractor shall, after completion of the original test of the installation, and acceptance of the Architect, provide any service incidental to the proper performance of the mechanical systems under guarantees outlined above for a period of one (1) year.

1.16 FINALLY

A. It is the intention that this specification shall provide a complete installation except as hereinbefore specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included.

B. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

Not Applicable.

END OF SECTION 22 05 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies the basic requirements for electrical components which are an integral part of packaged PLUMBING equipment. These components include, but are not limited to factory installed motors furnished as an integral part of plumbing equipment.

B. This section specifies the basic requirements for electrical components required to be furnished under Division 22, which are to be turned over to and installed by Division 26. These components include but are not limited to motors.

C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the drawings.

1.02 RELATED SECTIONS

A. Section 22 30 00 – Plumbing Equipment.

1.03 REFERENCES

A. NEMA Standards MG-1: Motors and Generators.

B. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment.

D. NEMA Standard KS 1: Enclosed Switches.

E. Comply with National Electrical Code (NFPA 70).

F. Compliance and Labeling: Provide motors and starters which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test electrical equipment and materials.

1.04 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.05 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.01 MOTORS

A. The following are basic requirements for simple or common motors, for special motors, more detailed and specific requirements are specified in the individual equipment specifications.
   1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
   2. Motor sizes shall be large enough so that driven load will not requirement the motor to operate in the service factor range.
   3. 2-speed motors shall be 2 separate windings on polyphase motors.
   4. Temperature Rating: Rated for 40 deg. environment, with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
   5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly timed spaced starts per hour for manually controlled motors.
   6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

B. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
   1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
   2. Bearings:
      a. Ball or roller bearings with inner and outer shaft seals;
      b. Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
      c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
      d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
   3. Enclosure Type:
      a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
      b. Guarded drip-proof motors where exposed to contact by employees or building occupants;
      c. Weather protected Type I for outdoor use, Type II where not housed;
   4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
   5. Noise Rating: "Quiet" rating on motors located in occupied spaces of building.
   6. Efficiency: Provide "Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a minimum efficiency as listed below.

1HP	80% Eff'y	10HP	87%
1-1/2 to 2HP	82%	15HP	89%
3HP	83%	20HP	90%
5HP	84%	25HP and up	91%
7-1/2 HP	85%		

C. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Baldor Electric Co.
Century Electric, Inc.
General Electric Co.
Marathon Electric Mfg. Co.
Reliance Electric Co.
Westinghouse Electric Corp.

D. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

PART 3 - EXECUTION

Not Applicable.

END OF SECTION 22 05 13

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for expansion compensation for the plumbing system.

1.02 RELATED SECTIONS

A. Section 22 10 05 – Plumbing Piping.

B. Section 22 30 00 – Plumbing Equipment.

C. Section 22 40 00 – Plumbing Fixtures.

1.03 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of expansion compensation product. Submit schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.

B. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes, location and method of attachment of anchors.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data in Maintenance Manual.

1.04 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service.

B. Comply with standards of the Expansion Joint Manufacturer's Association (EJMA).

PART 2 - PRODUCTS

2.01 PIPE ALIGNMENT GUIDES

A. General: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated. Construct with 4 finger spider traveling inside a guiding sleeve, with provision for anchoring to building substrate.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pipe alignment guides which may be incorporated in the work include, but are not limited to, the following:
Keflex, Inc. Metraflex (The) Co. or approved equal.

PART 3 - EXECUTION

3.01 EXPANSION LOOPS

A. General: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.

END OF SECTION 22 05 16

PART 1 - GENERAL

1.01 SCOPE

A. The requirements for seismic protection measures to be applied to plumbing equipment specified herein are in addition to any other items called for in other sections of these specifications. The seismic protection shall conform to Design Category "C" (verify with structural drawings) of the 2021 Arkansas Fire Prevention Code.

B. Flexible pipe connectors.

C. Pipe and equipment hangers and supports.

D. Equipment bases and supports.

E. Sleeves and seals.

1.02 REFERENCES

A. ASME B31.2 Fuel Gas Piping

B. ASTM F708 Design and Installation of Rigid Pipe Hangers.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 30 00 and Section 22 05 00.

B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping:
   1. Conform to ASME B31.9 and ASTM F708.
   2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 ISOLATION MATERIALS AND SUPPORT UNITS

A. Flexible Pipe Connectors:
1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.

2.05 SLEEVES

A. Sleeves for Pipes Thru Non-Fire Rated Floors: 18-gauge galvanized steel.

B. Sleeves for Pipes Thru Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.

C. Sleeves for Ductwork and Pipes Thru Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through bolt with recessed square steel plate and nut above slab.

3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1 1/2-inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00.

Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.04 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00. Refer to Structural Drawings for equipment pads. Coordinate exact size requirement for pads.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.

D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blowout.

E. Install chrome plated steel escutcheons at finished surfaces.

3.06 SCHEDULES

PIPE SIZE: Inches	MAX. HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2 to 1 1/4	6.5	3/8
1 1/2 to 2	10	3/8
2 1/2 to 3	10	1/2
4 to 6	10	5/8
C.I. Bell and Spigot or No Hub and at Joints	5	

END OF SECTION 22 05 49

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-22 sections.

B. Type of identification devices specified in this section include the following:

Plastic Pipe Markers.
Valve Tags.
Valve Schedule Frames.
Engraved Plastic-Laminate Signs.
Ceiling Tacks.

C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of the equipment assembly in other Division-22 sections.

1.02 RELATED SECTIONS

A. Section 22 10 05 – Plumbing Piping.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service.

B. ANSI Standards: Comply with ANSI A13.1 for lettering size, colors, and viewing angles of identification devices.

1.04 SUBMITTALS

A. Product Data: Submit product specifications and installation instructions for each identification material and device desired.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

PART 2 - PRODUCTS

2.01 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Plastic Pipe Markers:
   1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
      a. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
         (1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
         (2) Adhesive lap joint in pipe marker overlap.
         (3) Laminated or bonded application of pipe marker to pipe (or insulation).
      b. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
         (1) Laminated or bonded application of pipe marker to pipe (or insulation)
         (2) Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless-steel bands.
      c. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
      d. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
      e. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

C. Valve Tags:
   1. At the Contractor's option, provide one of the following:
      a. Brass Valve Tags: provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
      b. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32-inch-thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch square black tags with white lettering, except as otherwise indicated.
      c. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured

specifically for that purpose.

D. Valve Schedule Frames:
   1. General: For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on walls. Provide frames of rigid plastic or metal, with plastic glazing.

E. Engraved Plastic-Laminate Signs:
   1. General: Provide engraving stock melamine plastic laminate, complying with FS L- P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
   2. Thickness: 1/16 inch for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.
   3. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering plastic pipe markers which may be incorporated in the work include, but are not limited to, the following:

   Seton Name Plate Company
   EMED Co., Inc.
   Approved equal.

2.02 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/ maintenance of plumbing systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:
   1. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:
   1. Locate pipe markers and color bands as follows wherever piping is exposed

to view in occupied spaces, machine rooms, accessible maintenance spaces, (shafts, tunnels, plenums), exterior non-concealed locations and above removable acoustical ceilings.

a. Near each valve and control device.
b. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch, where there could be question of flow pattern.
c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
d. At access doors, manholes and similar access points which permit view of concealed piping.
e. Near major equipment items and other points of origination and termination.
f. Spaced intermittently at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
g. On piping above removable acoustical ceilings.

C. Valve Identification:
1. General: Provide valve tag on every valve, cock and control device in each piping system.
2. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
a. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

D. Plumbing Equipment Identification:
1. General: Install engraved plastic laminate sin on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Pumps and similar motor-driven units.
c. Fans, blowers, primary balancing dampers and mixing boxes.
d. Central-station units.
e. Tanks and pressure vessels.
f. Motor starters and other control equipment.

E. Refer to Division-23 sections for identification requirements of work; not work of this section.

F. Refer to Division-26 sections for identification requirements of electrical work; not work of this section.

G. Lettering Size: Minimum 3/8-inch-high lettering for name of unity where viewing distance is less than 2'-0"; 3/4 inch high for distances up to 6'-0"; and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 the size of principal lettering.

H. Text of Signs: In addition to name of identified unit, provide lettering to distinguish

between multiple units, and warn of hazards and improper operations.

I. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION 22 05 53

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Insulation Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping

C. Section 22 10 05 – Plumbing Piping.

D. Section 22 30 00 – Plumbing Equipment.

E. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

E. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

F. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

H. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

I. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

J. ASTM E96 - Water Vapor Transmission of Materials.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 22 0500.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer's Installation Instructions: Indicate procedures which ensure

acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/100 or less in accordance with ASTM E84, NFPA 255, and UL 723.

1.06 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 22 05 00.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

PART 2 - PRODUCTS

2.01 GLASS FIBER

A. Insulation: ASTM C547; rigid molded, noncombustible.
   1. "K" value: ASTM C335, 0.24 at 75 degrees F.
   2. Minimum Service Temperature: -20 degrees F.
   3. Maximum Service Temperature: 850 degrees F.
   4. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket:
   1. ASTM C921, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
   3. Secure with adhesive applied to longitudinal laps and butt strips.
   4. Secure with vapor barrier mastic.
   5. Self-sealing laps may be used provided lap seal is additionally sealed with vapor barrier masters.
   6. Maximum Water Vapor Transmission: 0.1 perm.

2.02 APPROVED MANUFACTURERS

A. Glass Fiber:
   1. Owens/Corning Fiberglass.

2. Architect Approved - Other acceptable manufacturers offering equivalent products.

B. Vapor Barrier Jacket Lap Adhesive - Compatible with insulation:
1. Foster 25.
2. Architect Approved.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory applied or field applied.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
3. Finish with glass cloth and vapor barrier adhesive.
4. PVC fitting covers may be used.
5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. For insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
3. Finish with glass cloth and adhesive.
4. PVC fitting covers may be used.
5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

E. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

F. Finish insulation at supports, protrusions, and interruptions.

G. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or stainless-steel jacket with seams located on bottom side of horizontal piping.

H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

J. Valves and fittings insulated with block insulation shall be finished with insulating cement and troweled to a smooth and uniform finish.

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS	THICKNESS
A. Plumbing Systems	
Domestic Hot Water Supply	1 inch
Domestic Hot Water Recirculation	1 inch
Domestic Cold Water (Indoors)	1/2 inch
Domestic Cold Water (Out of Doors)	1 inch
Storm Water	1 inch

END OF SECTION 22 07 19

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping

C. Section 22 30 00 – Plumbing Equipment.

D. Section 22 40 00 – Plumbing Fixtures.

1.03 QUALITY ASSURANCE

A. Manufacturers shall be firms regularly engaged in manufacturer of plumbing piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service.

B. Installer shall be a firm with successful installation experience on projects with plumbing piping system work similar to that required for project.

C. Comply with applicable provisions of ANSI B31.2 “Fuel Gas Piping”, applicable provisions of NFPA 54 (ANSI Z223.1) “National Fuel Gas Code”, ANSI Z223.1a “Supplement to National Fuel Gas Code” and with requirements of the local gas company.

D. Comply with applicable codes and standards.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 22 05 00.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer’s Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section.

PART 2 - PRODUCTS

2.01 DOMESTIC HOT AND COLD-WATER SYSTEMS

A. PIPE
1. Type “K” hard drawn copper, as made by Mueller Brass Co., for piping underground or beneath concrete slab.
2. Type “L” hard drawn copper, as manufactured by Mueller Brass Co., for above ground applications.

B. FITTINGS
1. Wrought copper.

C. CONNECTIONS
1. Sweat copper type with Stay-Safe “Bridgit” lead free silver bearing solder with Stay-Clean liquid or Stay-Clean paste flux as manufactured by J. W. Harris Co., Inc. Joints under slabs shall be brazed with Silfos brazing alloy.

D. VALVES
1. Use gate valves exclusively unless otherwise specified. All valves shall be by a single manufacturer from the approved list (reference Section 22 10 06). Valves shall be for 150psi SWP.
2. All valves shall be bronze, threaded ends, bronze ball and stem.

E. UNIONS
1. All union connections on piping 2” and smaller shall be ground joint brass union, having brass taper seat and both screw ends hexagonal and shall be designed for a steam working pressure up to 150 pounds.

F. ORIGIN
1. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.

2.02 SANITARY SEWER, SOIL, WASTE, VENT AND STORM PIPING SYSTEMS

A. PIPING
1. Piping - Reinforced Hub Type:
a. All piping shall be standard weight cast iron soil pipe and fittings unless noted otherwise, as manufactured by Tyler Pipe, Charlotte Pipe, or Griffin Pipe. All cast iron soil pipe and fittings shall be of the reinforced hub type, coated inside and outside with coal tar varnish and shall conform to the ASTM “Standard Specifications for Cast Iron Soil Pipe and Fittings”.
2. Soil, waste, drain and vent piping must be of sizes noted and run as indicated on the drawings, and shall be given a uniform grade of 1/4 inch per foot wherever possible, but in no case less than 1/8 inch per foot. The soil and waste pipes shall be extended through roof. Each riser extending through the roof shall project 10” above roof line. Flashing shall be by roofing contractor. Counter flashing shall be by plumbing contractor. Where so shown, connect vents below roof.

B. PIPE JOINTS
1. Hubless:
a. The cast iron hubless joint shall consist of cast iron soil pipe, fittings and Clamp All Corporation, Anaheim Foundry Co. “Husky”, or approved equal, hubless soil pipe couplings made of 24-gauge type 304 stainless steel with Hi-Torque Clamps tightened to 100-125

inch-pounds of torque. Coupling gaskets shall be made of neoprene and shall interlock with the housing assembly to make a slip free joint. Pipe and fittings shall be inserted into the sleeve and firmly seated against the center rib or shoulder of the gasket. A sound joint shall be provided in field cut lengths of pipe by having square cut ends as smooth as possible. The stainless-steel bands shall be tightened alternately and firmly to not less than 100 inch-pounds of torque.

2. Reinforced Hub Type:
   a. The reinforced hub cast iron soil pipes shall be joined with Tyler "Ty-Seal" neoprene joints.
   b. Support piping at each joint and fitting and 10"- 0' maximum spacing.

C. CLEANOUTS
1. Cleanouts shall be provided at the ends and points in change of direction of all drain, soil and waste pipes and branches thereof, at the foot of each riser, at all offsets, in all horizontal runs at approximately 50 foot intervals for piping 4" and smaller and 100' for larger piping, and at other points where indicated on the plans or where required.
2. All cleanouts in connection with cast iron pipe, except the traps and fittings on horizontal branches, shall have tapped "Y" fittings of same size as pipe up to 4 inches, and 4 inches for all larger pipe, closed with screw plugs. All other cleanouts in connection with cast iron pipe, except those that occur in finished floor and walls, shall have heavy cast iron ferrules same size as pipe up to 4 inches, and 4 inches for all larger pipe, caulked into hub and closed with a bronze screw plug.
3. All cleanouts in finished floors shall be Zurn ZN-1400-BP-LC "Level Trol", Wade, or Jay R. Smith, with anchor flange and clamp collar, scoriated nickel-bronze access cover and adjustable frame; bronze cleanout plug shall be straight threaded with tapered shoulder.
4. All cleanouts in finished walls shall be Zurn ZN-1443-BP, Wade, or Jay R. Smith with polished nickel-bronze access cover and adjustable frame; bronze cleanout plug shall be straight threaded with tapered shoulder.
5. All cleanouts on exterior piping of building shall be Zurn "Level-Trol" ZN-1400-BP-HD, Wade, or Jay R. Smith, having heaby duty bronze top, as detailed on the Drawings.

D. TRAPS AND DRAINS
1. P-traps shall be placed under all floor drains and where indicated in wastes, and at other points indicated on plans. P-traps shall be standard weight cast iron, ddep seal type, bell and spigot pattern.
2. Drains shall be Zurn, Wade, or Jay R. Smith, in accordance with the schedule on the drawings.

E. DRAIN PANS
1. All floor drains, except for those in concrete slab above earthfill, shall be provided with non-plasticized chlorinated polyethylene, "Chloraloy 240", brand concealed water proofing membrane as manufactured by the Noble Company of Grand Haven, Michigan, Compotite Corp. "Composeal", or approved equal. Membrane shall be medium gray in color, textured surface finish both sides, have white or black lettering continuously marked "Chloraloy 240", size 18 inches by 18 inches, turned up at least 1 inch, and

meet applicable standards of ASTM. Complete installation shall be in accordance with manufacturer's recommendations.

F. ORIGIN
1. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.

2.03 NATURAL GAS PIPING SYSTEM

A. Includes:
1. Necessary labor, materials, appliances and equipment required to provide gas service from existing campus master meter, building distribution system from (pound to ounce) pressure regulator valve at the building to gas fired equipment connections and accessories as shown on the drawings.
2. Related Work Specified Elsewhere:

B. Quality Assurance
1. Manufacturers shall be firms regularly engaged in manufacturer of natural gas piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
2. Installer shall be a firm with at least 3 years of successful installation experience on projects with natural gas piping system work similar to that required for project.
3. Comply with applicable provisions of ANSI B31.2 “Fuel Gas Piping", applicable provisions of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code", ANSI Z223.1a "Supplement to National Fuel Gas Code" and with

C. Natural Gas Piping Materials and Products
1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials use in natural gas piping systems. Where more than one type of material or product is indicated, selection is Installer's option.

D. Basic Identification
1. Provide identification complying with Division-15 Basic Materials and Methods, Section 15050 "Mechanical Identification".

E. Piping
1. Piping inside building shall be ASTM A-120-79, carbon steel, butt welded, Schedule 40 black steel.
2. Gas service outside building in ground shall be plastic pipe. Plastic pipe shall be "SDR-11 Driscopipe 6500" with copper trace wire, or approved equal, conforming to ASTM C2513. Connections and transition fittings shall be made by heat fusion, mechanical coupling. Mechanical coupling shall have internal stiffeners. Insulated fittings shall be provided at the meter and in the vertical rise above grade at the building. Transition fittings shall be provided at a minimum of 12 inches from all vertical risers to above grade. Gas piping shall be laid at least 24 inches below grade at all points.

3. Risers to building and to meter or pressure regulators shall be standard line pipe provided with a mill installed protective covering of Republic "X-Tru-Coat", high density polyethylene applied over an adhesive undercoating. All field joints and fittings shall be protected with Republic "X-Tru-Tape" and primer, applied as per manufacturer's recommendations. Pipe coat/wrap shall extend a minimum of 6 inches above finish grade.

F. Fittings
   1. Black Pipe:
      a. Welded forged steel fittings meeting requirements of ASTM A 234-79a, or standard weight malleable iron screwed.
   2. Fittings outside building shall have "X-Tru-Coat" covering.

G. Plug Valves (Cocks)
   1. 1 inch and smaller:
      a. Domestic Water shall be bronze, screw pattern, 125 psig, non-shock W.O.G. operating pressure, square head, lubricated tapered brass plug design, less check, FIP thread.
      b. Natural gas and HVAC shall be iron, screw pattern, 125 psig, non-shock W.O.G. operating pressure, square head, lubricated tapered brass plug design, less check, FIP thread.
      c. A.Y. McDonald Mfg. Co. #10686B, Dezurik/Sartell, or A/E approved equal.
   2. 1-1/4 inches thru 2 inches:
      a. Shall be semi-steel, screwed gland type, regular pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug, FIP thread and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; -A126, Class B and MSS SP-78.
      b. Rockwell Nordstrom Valves, Inc. #114, Resun or Homestead.
   3. 2-1/2 inches thru 4 inches:
      a. Shall be iron, screw gland type, regular pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug design, FIP thread or flanges drilled to ANSI class 125 cast iron flange standard template and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; ASTM-A126, Class B and MSS SP-78.
      b. Rockwell Nordstrom Valves, Inc. #115, Resun or Homestead.
   4. 6 inches and larger:
      a. Shall be iron, bolted gland type, short pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug design, flanges drilled to ANSI class 125 cast iron flange standard template and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; ASTM-A126, Class B and MSS SP-78.
      b. Rockwell Nordstrom Valves, Inc. #143, Resun or Homestead.

H. Pressure Regulating Valves
   1. Provide single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded ends for 2 inches and smaller, flanged ends for 2-1/2 inches and larger; for inlet and outlet gas pressures, specific gravity, and volume flow indicated.
   2. Regulators installed indoors shall be vented to outside full size or larger as required to eliminate excessive back pressure.
   3. Regulators installed outdoors shall be installed such that vent face is

downward, so as to avoid the entry of water and matter which would interfere with its operation.

4. Regulators shall be equal to Sensus or approved equal with internal relief.

PART 3 - EXECUTION

3.01 HOT AND COLD-WATER PIPING SYSTEMS

A. For general piping insulation, see Section 22 07 19.

B. Install copper tubing under slabs without joints where possible.

C. Provide adaptors in copper lines for all valves.

D. Locate cold water lines a minimum of 12 inches from hot water line.

E. Before pipes are covered, test systems in presence of Architect at 100 psi hydrostatic pressure for two (2) hours and show no leaks.

F. Sterilize domestic water system with solution containing at least 250 parts per million of available chloride. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and faucets several times during that time.

G. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.

H. Water system will not be accepted until a negative bacteriological test is made on water taken from system and dosing shall be repeated as necessary until such negative test is accomplished. Submit written report of test to Architect for his approval.

I. Install water hammer arresters as noted on the drawings.

J. Extend water service piping of size and in location indicated to water service entrance at building. Provide sleeve in foundation wall for water service entry; make entry weathertight. Provide gate valve at water service entry inside building, strainer, pressure gauge, test tee and valve.

K. Provide hot and cold-water piping runouts to fixtures of sizes indicated, but in no case smaller than required by National Standard Plumbing Code.

L. Connect hot and cold-water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shut-off valve and union for each connection. Provide drain valve on drain connections.

3.02 SANITARY SEWER, SOIL, WASTE, VENT AND STORM PIPING SYSTEMS

A. Provide floor drains and other specialties as specified in the Schedule on the drawings and set forth in these specifications.

B. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gasses

pass freely to atmosphere with no pressure of syphon condition on water seal.

C. Before piping is covered, conduct tests in presence of Architect and correct leaks or defective work. Do not caulk threaded work. Fill waste and vent system to roof level (a minimum of 10 feet) with water and show no leaks for two (2) hours.

D. Vent entire system to atmosphere. Discharge 14 inches above roof. Joint lines together in fewest practicable number before projecting above roof. Set back vent lines so they will not pierce roof near an edge or valley.

E. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.

F. Flash pipes passing through roof with six (6) lb/sq.ft. lead flashing fitted around pipes and turned down into pipe 1/2 inch with turned edge hammered against pipe wall.

3.03 INSTALLATION OF NATURAL GAS PIPING

A. Install natural gas distribution piping in accordance with applicable codes and local Utility Company requirements.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

C. Remove cutting and threaded burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped, or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

F. Install minimum 6-inch-long drip-legs in gas piping where indicated, and where required by code or regulation.

G. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.

H. Use dielectric unions where dissimilar metals are joined together.

I. Install piping with 1 inch drop in 60-foot pipe run (0.14%) in direction of flow.

J. Install piping parallel to other piping, but maintain minimum of 12-inch clearance between gas piping and steam or hot water piping above 200 degrees F.

K. Wrap and lay underground pipe with minimum of two (2) feet of cover in accordance with local gas utility company regulations and specifications.

L. Install gas cocks and unions at all final connections to equipment.

M. Do not use flexible pipe connections.

N. All field joints and fittings shall be protected with "X-Tru-Tape" and primer.

O. Bushings will not be accepted.

P. Test all gas piping with air pump and 3-inch dial gauge to pressure that will maintain 25 psig for 15 minutes.

Q. Provide sacrificial type cathodic protection for each vertical riser to the building.

R. Provide 5/8 inch by 8'-0" copper slad steel ground rod, ground rod clamp and No. 6 stranded copper conductor from ground rod to vertical riser at every instance where piping exits the earth.

3.04 GAS SERVICE

A. Consult with Gas Company as to extent of its work, meter requirements with consideration of Owner needs, costs, fees, and permits involved. Pay such costs and fees; obtain permits.

END OF SECTION 22 10 05

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Valves and piping specialties, for complete Plumbing System.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 10 05 – Plumbing Piping.

E. Section 22 30 00 – Plumbing Equipment.

F. Section 22 40 00 – Plumbing Fixtures.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service.

1.04 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for pipeline strainers. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required pipeline strainer.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of pipeline strainer. Include this data in Maintenance Manual.

PART 2 - PRODUCTS

2.01 MANUFACTURED PIPING SPECIALTIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Pipe Escutcheons:
1. General: Provide pipe escutcheons as specified herein with inside diameter

closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings, and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist and Wet Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

C. Low Pressure Y-Type Pipeline Strainers:
1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64 inch perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping system.
2. Threaded ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering low pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:

American Air Filter, an Allis-Chalmers Co.
Armstrong Machine Works.
Hoffman Specialty, ITT Fluid Handling Div.
Metraflex Co.
Sarco Co., Div. of White Consolidated.
Trerice (H.O.) Co.
Victaulic Co. of America

D. High Pressure Y-Type Pipeline Strainers:
1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi working pressure, with Type 304 stainless steel screens, with 3/64" perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping systems.
2. Threaded Ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted steel retainer with off-center blowdown fitted with pipe plug.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:

American Air Filter, an Allis-Chalmers Co.
Armstrong Machine Works.
Hoffman Specialty, ITT Fluid Handling Div.
Metraflex Co.
Sarco Co., Div. of White Consolidated.
Trerice (H.O.) Co.

Victaulic Co. of America

E. Dielectric Unions:
1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolates ferrous from non-ferrous piping (electrical conductance), present galvanic action, and stop corrosion.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dielectric unions which may be incorporated in the work include, but are not limited to, the following:

Atlas Products Co.
Capital Mfg. Co., Div. of Harsco Corp.
Eclipse, Inc.
Epco Sales, Inc.
FMC Corp.
McNally, Inc.
PSI Industries.
Stockham Valves and Fittings.

2.02 FABRICATED PIPING SPECIALTIES

A. Drip Pans: Provide drip pans fabricated from not less than 18-gauge corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2 inches. Reinforce top, either by structural angles or by rolling top over 1/4 inch steel rod, provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

B. Pipe Sleeves: Provide pipe sleeves of one of the following:
1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with SnapLock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3 inches and smaller, 20-gauge; 4 inches to 6 inches, 16-gauge; over 6 inches, 14-gauge.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe, remove burrs.

C. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:
1. Lead and Oakum: Caulked between sleeve and pipe.
2. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical sleeve seals which may be incorporated in the work include, but are not limited to following:

Thunderline Corp.

2.03 VALVES

A. General: Provide factory-fabricated valves recommended by manufacturer for

use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections.

2.04 GATE VALVES

A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

B. Comply with the following standards.
   1. Cast-Iron Valves: MSS SP-70.
   2. Bronze Valves: MSS SP-80.
   3. Steel Valves: ANSI B16.34.

C. For Domestic Water Service:
   1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Nibco T-111-LF.
   2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Nibco F-617-0.

D. For Fire Protection Service:
   1. Threaded Ends 2 inches and smaller: Class 125, bronze body, yoke bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham B-133.
   2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body, bolted bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham G-634.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to, the following:
   1. Milwaukee Valve Company.
   2. Nibco Valve Company.
   3. Stockham Valves and Fittings, Inc.

2.05 GLOBE VALVES

A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

B. Composition Discs: Where required, provide suitable material for intended service. For stem throttling service, fit composition disc valve with throttling nut. For metal seated globe valves, provide hardened stainless steel disc and seat ring.

C. Comply with the following standard:
   1. Cast-Iron Valves: MSS SP-85.
   2. Bronze Valves: MSS SP-80.
   3. Steel Valves: ANSI B16.34.

D. For Domestic Water Service:
   1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, composition disc, Nibco T-211-Y.
   2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body, bronze trimmed, bolted bonnet, rising stem, OS&Y, renewable seat and disc, Nibco F-718-8.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe valves which may be incorporated in the work include, but are not limited to, the following:
   1. Milwaukee Valve Company.
   2. Nibco Valve Company.
   3. Stockham Valves and Fittings, Inc.

2.06 DRAIN VALVES

A. For Low Pressure Drainage Service:
   1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4 inch hose outlet connection, Milwaukee 1152M.
   2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drain valves which may be incorporated in the work include, but are not limited to, the following:
      a. Milwaukee Valve Company.
      b. Nibco Valve Company.
      c. Stockham Valves and Fittings, Inc.

2.07 BALL VALVES

A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

B. Comply with the following standards:
   1. Steel Valves: ANSI B16.34.

C. For Domestic Water Service:
   1. Threaded Ends 2 inches and smaller: Class 125, bronze 2 piece body, stainless steel ball, bronze extended stem, Apollo 77C-14X-04.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work include, but are not limited to the, the following:
   1. Milwaukee Valve Company.
   2. Nibco Valve Company.
   3. Stockham Valves and Fittings, Inc.
   4. Apollo Valves.

2.08 SWING CHECK VALVES

A. General: Construct pressure containing parts of valves as follows:
   1. Bronze Valves, 125 or 150 psi: ANSI/ASTM B62.
   2. Metallic Seated Bronze Valves, 200 or 300 psi: ANSI/ASTM B61.
   3. Iron Body Valves: ANSI/ASTM A126, Grade B.

B. Comply with MSS SP-71 for design, workmanship, material, and testing.

C. Construct valves of pressure castings free of any impregnating materials.

D. Construct valves of bronze, regrinding, with seating angle 40 degrees to 45 degrees, unless composition disc is specified.

E. Provide stop plug as renewable stop for disc hanger, unless otherwise specified.

F. Construct disc and hanger as separate parts, with disc free to rotate.

G. Support hanger pins on both ends by removable side plugs.

H. For Domestic Water Service:
   1. Threaded Ends 2 inches and smaller: Class 125, bronze body, screwed cap, horizontal swing, bronze disc, Nibco T-413-LF.
   2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Nibco F-918-B.

I. For Fire Protection System:
   1. Threaded Ends 2 inches and smaller: Class 200, bronze body, bolted cap, horizontal swing, composition disc, UL listed, Stockham B-305-B.
   2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, malleable iron disc, UL/FM approved, Stockham G-939.

J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work include, but are not limited to, the following:
   1. Milwaukee Valve Company
   2. Nibco Valve Company.
   3. Stockham Valves and Fittings, Inc.

2.09 VALVE FEATURES

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.

B. Bypass: Comply with MSS SP-45, and except as otherwise indicated provide manufacturer's standard bypass piping and valving.

C. Drain: Comply with MSS SP-45, and provide threaded pipe plug complying with Division-15 "Pipe, Tube, and Fittings" section.

D. Flanged: Valve flanges complying with ANSI B16.5 (steel) or ANSI B16.24 (bronze).

E. Threaded: Valve ends complying with ANSI B2.1.

F. Butt-Welding: Valve ends complying with ANSI B16.25.

G. Flangeless: Valve bodies manufactured to fit between flanges complying with

ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

H. Wafer: Flangeless valves.

I. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry.

J. Non-Metallic Disc: Non-metallic material selected for service indicated in accordance with manufacturer's published literature.

K. Renewable Seat: Design seat of valve with removable disc, and assembly valve so disc can be replaced when worn.

L. Extended Stem: Increase stem length by 2 inches minimum, to accommodate insulation applied over valve.

M. Mechanical Actuator: Factory-fabricated gears, gear enclosure, external chain attachment, and chain designed to provide mechanical advantage in operating valve.

N. Bonnet: Part of gate or globe valve through which stem passes to valve body, and attached to valve body by screws, bolts, union, or welding.

O. Solid Wedge: One-piece tapered disc in gate valve, designed for contact on both sides.

P. Outside Screw and Yoke: Stem and handwheel designed to rise out of bonnet or yoke as valve is operated from closed to open position.

2.10 PLUG VALVES (COCKS)

A. Valve body shall be screw pattern, iron, except that sizes 1-1/4 inches through 2 inches shall be semi-steel, rated for 125 psig, non-shock W.O.G. operating pressure.

B. Plug shall be tapered, lubricated brass with square head operator.

C. APPROVED MANUFACTURERS
1. 1-inch and smaller - A. Y. McDonnel Manufacturing Company #10686.
2. 1-1/4 inches through 1-1/2 inches - Nordstrom #114.
3. 2-1/2 inches and larger - Nordstrom #115.
4. Architect Approved.

2.11 PRESSURE RELIEF VALVES

A. Body: Bronze or iron with testing lever.

B. Trim: Bronze or stainless steel.

C. Construction: Comply with ASME Code for Pressure Vessels, Section VIII and shall bear ASME stamp.

D. Maximum Permissible over Pressure: 25 percent (water).

E. APPROVED MANUFACTURERS
1. Bell and Gossett.
2. McDonnell Miller.
3. Kunkle Valve Company.

2.12 PRESSURE REDUCING VALVES

A. Body: Cast iron.

B. Trim: Bronze.

C. Rating: 125 psig working pressure at 200 degrees F.

D. Operator: Spring loaded diaphragm with adjustable range.

E. Diaphragms and Disc: Nitrile.

F. Pressure Reducing Valves - Water Service:
1. Spence Regulators - Type D 34.
2. Watts Regulators.
3. Architect Approved.

2.13 BACK FLOW PREVENTERS

A. Reduced pressure type. Rated 175 psig at 140 degrees F, manufactured in the United States of America.

B. Body:
1. Bronze construction.
2. Bronze body test cocks.
3. NPT body connections.
4. Non-rising stem gate valves.

C. Check Valve:
1. Celcon seats.
2. Rubber check valve.

D. Relief Valve:
1. Stainless steel seat.
2. Stainless steel shaft and flange bolts.

E. APPROVED MANUFACTURERS
1. Watts Regulator Series 909-SAG.
2. Wilkins Regulators.
3. Febco.

2.14 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of

hangers and supports to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

B. Adjustable Steel Clevises: MSS Type 1.

C. Steel Double Bolt Pipe Clamps: MSS Type 3.

D. Adjustable Swivel Pipe Rings: MSS Type 6.

E. Split Pipe Rings: MSS Type 11.

F. Extension Split Pipe Clamps: MSS Type 12.

G. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange.

H. Pipe Stanchion Saddle: MSS Type 37, including steel pipe base support and cast-iron floor flange.

I. Adjustable Pipe Saddle Supports: MSS Type 38 including steel pipe base support and cast-iron floor flange.

J. Single Pipe Rolls: MSS Type 41.

K. Adjustable Roller Hangers: MSS Type 43.

2.15 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

C. Four-Bolt Riser Clamps: MSS Type 42.

2.16 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13.

C. Swivel Turnbuckles: MSS Type 15.

D. Malleable Iron Sockets: MSS Type 16.

E. Steel Weldless Eye Nuts: MSS Type 17.

2.17 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Concrete Inserts: MSS Type 18.

C. Top Beam C-Clamps: MSS Type 19.

D. Side Beam or Channel Clamps: MSS Type 20.

E. Center Beam Clamps: MSS Type 21.

F. C-Clamps: MSS Type 23.

G. Top I-Beam Clamps: MSS Type 25.

H. Side I-Beam Clamps: MSS Type 27.

I. Steel I-Beam Clamps with Eye Nut: MSS Type 28.

J. Steel WF-Beam Clamps with Eye Nut: MSS Type 29.

K. Malleable Beam Clamps: MSS Type 30.

L. Steel Brackets: One of the following for indicated loading:

Light Duty: MSS Type 31.
Medium Duty: MSS Type 32.
Heavy Duty: MSS Type 33.

2.18 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields for piping hangers and supports, factory-fabricated, for all insulated piping. Side saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

2.19 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hangers and supports which may be incorporated in the work include, but are not limited to the following:

C & S Mfg. Corp.
Carpenter and Patterson, Inc.
Elcen Metal Products Co.
F & S Central Mfg. Corp.
ITT Grinnell Corp.

2.20 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA Std. ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A36.

C. Cement Grout: Portland cement (ANSI/ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for load required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), by cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.01 INSTALLATION OF MANUFACTURED PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2 inches and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment.

   Pumps.
   Steam traps serving steam main drips.
   Temperature control valves.
   Pressure reducing valves.
   Temperature or pressure regulating valves.

C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

3.02 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments; weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1 inch drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less that 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface except floor sleeve. Extend floor sleeves 1/4 inch above level floor finish, and 3/4 inch above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.
   1. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings.
   2. Install iron-pipe sleeves at exterior penetrations, both above and below grade.
   3. Install steel-pipe sleeves except as otherwise indicated.

C. Sleeve Seals: Install in accordance with the following:
   1. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

3.03 INSTALLATION OF VALVES

A. General: Except as otherwise indicated, comply with the following requirements.
   1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
   2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.

D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves in steam and condensate service and in other services where corrosion is indicated or can be expected to occur.

E. Mechanical Actuators: Install mechanical actuator with chain operators where indicated, and where valves 4" and larger are mounted more than 7'-0" above floor in mechanical rooms, boiler rooms; and where recommended by valve manufacturer because of valve size, pressure differential or other operating condition making manual operation difficult.

F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections.
   1. Pipe Size 2 inches and smaller: One of the following, at Installer's option:
      a. Threaded valves.
      b. Grooved-end valves (Fire Protection Only).
      c. Flanged valves.
   2. Pipe Size 2-1/2 inches and larger: One of the following, at Installer's option:
      a. Grooved-end valves (Fire Protection Only).
      b. Flanged valves.

G. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

H. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

I. Renewable Seats: Select and install valves with renewable seats except where otherwise indicated.

J. Fluid Control: Except as otherwise indicated, install, gate, ball, globe and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal reason for valve, install globe or butterfly valve.

K. Installation of Check Valves:
   1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.
   2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.
   3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
   4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.

L. All domestic hot and coldwater piping shall have gate valves with threaded ends, solder ends not acceptable. Ball valves shall not be substituted for gate valves or plug valves. Install ball valves only where shown on drawings.

3.04 INSTALLATION OF BACKFLOW PREVENTERS

A. Install backflow preventers where shown on the plans with elbow and air gap, and as may be required to prevent cross contamination of potable water systems.

B. Pipe discharge drain to nearest floor drain.

3.05 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.06 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations, within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-59. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.07 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping, ductwork or other supported mechanical or electrical items.
   1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
   2. Support fire-water piping independently of other piping.
   3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

B. Provisions for Movement:
   1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion bends and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

C. Insulated Piping: Comply with the following installation requirements.
1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized coated protective shields. Install Foam-Glas insulation saddles.
3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.08 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximum recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.09 ADJUSTMENT OF HANGERS AND SUPPORTS

A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

3.10 EQUIPMENT BASES

A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Structural steel stands to be supported from housekeeping pad bases. Steel supports shall not be allowed to be in direct contact with slab floors.

END OF SECTION 22 10 06

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Water Heaters.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping

C. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

D. Section 22 10 05 – Plumbing Piping.

E. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.

D. ANSI/NFPA 54 - National Fuel Gas Code.

E. ANSI/NFPA 70 - National Electrical Code.

F. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 22 05 00.

B. Shop Drawings:
   1. Include heat exchanger dimensions, size of tappings, and performance data.
   2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

C. Product Data:
   1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Provide electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA:

A. Submit under provisions of Division 01 and Section 22 05 00.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with Arkansas State Plumbing Code.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
4. National Electrical Manufacturers' Association (NEMA).
5. Underwriters Laboratories (UL).

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 REGULATORY REQUIREMENTS

A. Conform to AGA, NSF, NBBPVI, ANSI/NFPA 54, ANSI/NFPA 58, ANSI/NFPA 70, ANSI/UL 174, and ANSI/UL 1453 requirements for water heaters.

B. Conform to ASME Section VIIID for manufacture of pressure vessels for heat exchangers.

C. Conform to ASME Section VIIID, ANSI/NFPA 30, and ANSI/NFPA 31 for tanks.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 22 05 00.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

A. Provide one year warranty under provisions of hereinafter setforth.

B. Warranty: Include coverage of domestic water heaters.

PART 2 - PRODUCTS

2.01 ELECTRIC WATER HEATERS

A. REFER TO PLUMBING EQUIPMENT SCHEDULE ON DRAWINGS.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, ANSI/NFPA 54 and UL requirements.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Install tanks in accordance with manufacturer's instructions.

D. Pipe relief valves and drains to nearest floor drain or as noted on drawings.

3.02 GUARANTEE

A. The entire installation shall be guaranteed for one (1) year against defective equipment, materials and workmanship beginning on signing of substantial completion form.

END OF SECTION 22 30 00

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for Plumbing Fixtures.

1.02 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing Piping and Equipment.

B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 22 10 05 – Plumbing Piping.

D. Section 22 30 00 – Plumbing Equipment.

1.03 QUALITY ASSURANCE

A. Die-cast zinc alloy will not be accepted.

B. All faucets, stops, and traps shall be of the same manufacturer unless herein noted otherwise.

C. Corrosion-resistant steel (CRS).
1. CRS flat products shall conform to not less than chemical composition requirements of any 300 series steel specified in ASTM A276.
2. Exposed surfaces shall have standard polish (ground and polished) equal to Finish No. 4 as specified in NAAMM.

D. All enameled ironware shall be acid resisting.

E. All fixtures shall be new and best of their respective kinds. They shall be non-absorbent throughout and free from waves, kiln marks or discoloration.

F. All surfaces coming in contact with walls, floors, or surface of other fixtures shall be ground truly flat and shall be bedded with fine dental plaster before being caulked to wall with silicone sealant.

G. Job must be turned over to the Owner with all fixtures clean and free from damage. All fixtures including service sinks shall be protected during construction with application of material sufficient to prevent use and damage by personnel and equipment.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 22 05 00.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 and Section 22 05 00.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 22 05 00.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by the manufacturer.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

1.08 WARRANTY

A. Provide year warranty under provisions of Section 22 05 00.

1.09 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.

1. American National Standards (ANSI):
   A112.1.2-42.....Air Gaps in Plumbing System
   A112.6.1M-79.....Supports for Off-the-Floor Plumbing Fixtures for Public Use
   A112.18.1M-79....Finished and Rough Brass Plumbing Fixture Fittings
   A112.19.1M-79....Enameled Cast Iron Plumbing Fixtures
   A112.19.2-82.....Vitreous China Plumbing Fixtures
2. American Society for Testing and Materials (ASTM):
   A276-83.....Stainless and Heat-Resisting Steel Bars and Shapes
3. National Association of Architectural Metal Manufacturers (NAAMM):
   Metal Finishes Manual.

PART 2 - PRODUCTS

2.01 GENERALLY

A. This contractor shall furnish and install complete all fixtures shown on the plans and hereinafter specified.

B. All fixtures shall be new and best of their respective kinds. They shall be non-absorbent throughout and free from waves, kiln marks or discoloration.

C. All surfaces coming in contact with walls, floors or surface of other fixtures shall be ground truly flat and shall be bedded with fine dental plaster before being caulked to wall with silicone sealant.

D. All fixtures shall have water hammer arresters equal to Zurn, Wade or approved equal, installed in their water supplies as shown on Drawings or as recommended by the shock absorber manufacturer.

E. Provide polished chromium plated, heavy brass lock-shield loose key or screwdriver pattern angle stops, straight stops, or stops integral with faucet, with each compression type faucet whether specifically called for or not. Locate stops centrally above or below fixture in accessible location. Furnish keys for lock-shield stops to Owner upon completion of installation. All supplies shall be I.P.S. brass, McGuire, Zurn.

F. Traps shall be two-piece chrome plated cast brass P-traps with cleanout and 17 gage tubing outlet with escutcheon.

G. All escutcheons on supplies and wastes shall be heavy chrome plated cast brass set screw type.

H. All faucets throughout shall have removable units comprising all the wearing parts.

I. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.

J. Unless specifically specified otherwise, all fixture trim, stops, and traps shall be of the same manufacturer.

K. Protect fixtures against use and damage during construction in a manner approved by the Architect. Job must be turned over to the Owner with all fixtures and trim clean and free from damage. Fixtures shall not be used during construction unless approved by the Owner and/or Architect/Engineer.

L. All sink and lavatory type plumbing fixtures to have loose key type stops and flexible supply risers (unless noted otherwise).

M. All exposed plumbing piping shall be chrome plated unless noted otherwise.

N. The Contractor must review the Architectural Drawings for exact location of plumbing fixtures and floor drains. If a plumbing fixture or floor drain is shown on the Architectural Drawings, it must be included in the Contract even if it does not appear on the Mechanical Drawings.

O. All thermostatic and pressure balancing mixing valves shall have checkstops on the hot and cold supplies.

P. All hot and cold water supplies to plumbing fixtures or to shower heads shall have a “Drop Ell” fitting securely attached, inside wall, to prevent movement.

Q. All lavatory or sink fixtures designated for handicapped use must have insulation installed on the water supplies and P-trap equal to "Lav-Guard" by Truebro, Inc or approved equal.

R. All drinking fountain bubblers shall be chrome-plated brass.

S. All lavatory and urinal waste arms shall be DWV copper with cast brass adapters and wrought copper fittings.

T. All water closet flush valves that have grab bars mounted on walls behind them shall have a minimum of 1-1/2 inch flush valve pipe offset to clear grab bar. Coordinate with Architectural drawings.

U. All handicapped water closet flush valves shall be roughed-in and installed so that the flush valve control will be on the wide side of the toilet stall. Contractor shall coordinate this.

V. All water closet flush valves shall have cast wall flange with set screw, and be supplied with sweat-solder adapter kits.

W. Check millwork architectural and shop drawings. Verify exact location and size of fixtures and openings before rough-in and installation. Coordinate with millwork supplier for special cutouts, blocking, special or additional supports, etc.

X. This contractor shall furnish and install all backing for lavatories, or any equipment requiring same.

Y. Job must be turned over to the Owner with all fixtures clean and free from damage.

Z. Where water closets, lavatories or sinks are installed back-to-back, and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers, unless noted otherwise on Drawings.

2.02 STOPS

A. Provide polished chromium plated, heavy brass lock-shield loose key or screw driver pattern angle stops, straight stops, or stops integral with faucet, with each type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture. Locate stops centrally above or below fixture in an accessible location with 6-inch minimum length chrome plated brass nipples from wall and escutcheon. Furnish keys for lock-shield stops to Owner upon completion of installation.

2.03 TRAPS

A. Two-piece chromium plated cast brass with cleanout and 17-gauge tubing outlet with cast brass set screw type escutcheon.

2.04 ESCUTCHEONS

A. All escutcheons on supplies and wastes shall be heavy pattern, chrome plated, cast brass set screw type.

2.05 FAUCETS

A. All faucets shall be provided with aerators unless specified otherwise and shall have removable units comprising all the wearing parts.

2.06 CARRIERS

A. Where water closets, lavatories or sinks are installed back-to-back, and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers.

2.07 FIXTURES

A. REFER TO PLUMBING FIXTURE SCHEDULE ON DRAWINGS.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fixture Setting: Opening between fixture and floor and wall finish shall be caulked with white or clear Silicone sealants, which complement the fixture color.

B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls, etc. with brass through bolts, toggle bolts, expansion bolts, or power set fasteners, as required. Exposed heads of bolts and nuts in finished rooms to be hexagonal, polished chromium-plated brass with rounded tops.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Install components level and plumb secured in place with wall carriers and bolts.

3.03 ADJUSTING

A. Adjust work under provisions of Section 22 05 00.

B. Provide adjustment of all stops, valves faucets, etc., for intended water flow rates to fixtures as required to eliminate excessive splashing, noise, or overflow.

C. Where water closet waste pipe has to be offset due to beam interference, provide correction and/or additional piping necessary to eliminate relocation of water closet.

3.04 CLEANING

A. At completion of all work, fixtures, exposed materials, accessible chases and equipment shall be thoroughly cleaned of all manufacture’s labels, papers, paint, paste, and other foreign material.

3.05 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as herein specified and indicated on the Architectural drawings. Architectural drawings shall rule where discrepancies occur.

END OF SECTION 22 40 00

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for complete heating, ventilating, and air conditioning system.

1.02 RELATED SECTIONS

A. Section 23 21 13 – Hydronic Piping.

B. Section 23 31 00 – HVAC Ducts and Casings.

C. Division 23 – All Sections.

D. Division 26 – All Sections.

1.03 SITE INSPECTION

A. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.

B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

1.04 DRAWINGS

A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc. Follow closely as actual building construction and work of other trades will permit.

B. Consider architectural and structural drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over mechanical drawings.

C. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories required to meet the conditions.

D. Record difference between mechanical work as installed and as shown in Contract Documents on a set of prints of mechanical drawings to be furnished by Architect. Return these prints to Architect at completion of project. These will be labeled "Contractor Revised Drawings".

1.05 SUBSTITUTIONS

A. The naming of specified items on the drawings or in the specifications is intended to establish a level of quality and performance. Substitution requests may be submitted at the time of shop drawing submittal. Review of substituted equipment or material prior to the Bid Date will not be considered unless otherwise specified.

B. Substitution shall be submitted as specified in Division 01.

1.06 CODE REQUIREMENTS, FEES & PERMITS

A. Perform work in accordance with applicable provisions of state and local Plumbing Code, gas ordinances and adoptions thereof. Provide materials and labor necessary to comply with rules, regulations and ordinances.

B. In case of differences between building codes, state laws, local ordinances, utility company regulations and Contract Documents, the most stringent shall govern. Promptly notify Architect in writing of such differences.

1.07 CONTRACTOR REVISED DRAWINGS

A. The contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job.

B. Exact location of all underground utility service entrances and their connections to utility mains, well heads, loop piping and all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances.

C. Upon completion of the work and prior to final payment, the contractor shall furnish to the Architect, one set of "contractor revised" prints, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.

D. Contractor shall include all addendum items and field change order information on the revised drawings. Revise all schedules shown on the drawings to reflect the actual model numbers, capacities and electrical characteristics of substituted equipment.

1.08 VISIT SITE

A. This contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause for extras after the contract is signed by reason of unforeseen conditions. Any existing electric wiring and conduit, gas, water drainage piping encountered within the building area shall be relocated or removed where required by this contractor at no extra cost to the Owner.

1.09 COORDINATION OF WORK

A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to Architect. Should conditions arise where certain changes would be advisable, secure Architect's approval of these changes before proceeding with work.

B. Coordinate work of various trades in installing inter-related work. Before installation of mechanical items, make proper provisions to avoid interferences in a manner approved by Architect. Changes required in work specified in Division 23 caused by neglect to do so shall be made at no cost to Owner.

D. Provide inserts and supports required by Division 23 unless otherwise noted. Furnish sleeves, inserts, supports and equipment that are an integral part of other divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location of installation of items above shall be borne by Division 23.

E. Be responsible for required digging, cutting and patching incident to work of this Division and make required repairs afterward to satisfaction of Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns or trusses.

1. Each Section of this Division shall bear expense of cutting, patching, repairing and replacing of work of other Sections required because of its fault, error, tardiness or because of damage done by it.
2. Cutting, patching, repairing and replacing pavements, sidewalks, roads and curbs to permit installation of work of this Division is responsibility of Section installing work.

F. Adjust locations of pipes, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.

1. Make offsets, transitions, and changes in direction of pipes, as required to maintain proper headroom and pitch of sloping lines whether or not indicated on Drawings.

G. Slots and openings through floors, walls, ceilings and roofs shall be provided by other Divisions in their respective materials. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.10 EXCAVATION AND TRENCHING FOR PIPING

A. Excavate to the depths indicated on the Drawings or as otherwise specified. Consult with Geotechnical Engineer for trenching requirements due to heaving soil. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulated therein shall be removed by pumping or by other approved method. Do sheeting and shoring as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of trench may be tunneled if the pipe can be safety and properly installed and backfill can be properly tamped in such tunnel sections.

B. Trench Excavation: Bottom of trench for tile or concrete pipe shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered, excavate to a minimum overdepth of 4" below trench depths indicated on the drawings or specified. Overdepths in rock

excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered, such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

C. Depth of Cover: Trenches shall be of depth that will provide a minimum depth of cover of three feet for water, sanitary and storm sewer and two feet for gas piping from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

1.11 BACKFILLING OF TRENCHES

A. Trenches shall not be backfilled until required pressure and other tests have been performed, inspection of utility and Code officials have been accomplished, and until the utilities systems as installed conform to requirements of drawings and specifications.

B. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones over 2-1/2-inch maximum dimension, deposited in 6-inch layers and compacted to 95% of the maximum laboratory density determined in accordance with ASTM D-698, Moisture-Density Relation of Soils. Tests for maximum density will be made with expense borne by contractor. If fills fail to meet the specified densities, the contractor shall remove and recompact the fill until specified densities are achieved.

C. Tests for Displacement of Sewers: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the contractor at his expense.

1.12 GENERAL PIPING INSTALLATION

A. Furnish and install a complete system of piping. The piping drawings are diagrammatic and indicate the general location and connections. If the size of any piping is not clearly evident, obtain instructions from the Architect before proceeding with the work. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the contractor from responsibility for the proper erection of systems of piping in every respect suitable for the work intended. Piping systems that are not to be installed complete shall be so noted.

B. Erection: Piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing. Remove all burrs and cutting slag by reaming or other cleaning methods. Changes in direction shall be made with fittings, except that bendings of pipe will be permitted, providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles, or other malformation will not be acceptable. Piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access manholes or other access openings. Piping shall be installed to insure noiseless circulation.

C. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified:

Type of Piping Fluid Conveyed	System Component	Length for 1" Fall	Direction of Fall
Condensate	Return main	20 feet	Condensate flow
Heating Water Chilled Water	Runouts to radiation or risers	4 feet	Back to mains
Heating Water	Supply and return	Level	
Chilled Water	Supply and return	Level	
Condensing Water	Supply and return	Level	

D. Protection: Open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs or rags, wood, cotton, concrete, waste or similar materials must not be used in plugging.

E. Installation of Underground Pipe: Bottom of trench shall be shaped to give substantially uniform circumferential support to lower third of each pipe. Pipe shall be laid true to line and grade in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, interior of pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drain shall be kept in pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing has set and pipe shall not be laid when condition of trench or weather is unsuitable for such work.

F. Cleaning and Flushing: Contractor shall take every precaution to remove dirt, grease, and all other foreign matter from each length of piping before making connections in the field. After each section of piping is installed, it shall be flushed with clean water except where specified otherwise.

G. Pipe Sizes: If the size of any piping is not clearly evident in the drawings, the contractor shall request instructions from the Architect as to the proper sizing. Any changes resulting from the contractor's failure to request clarification shall be at his expense.

1.13 THERMAL AND MOISTURE PROTECTION

A. Install flashing, counterflashing and caulk or seal all penetrations in exterior walls or floors as required to prevent exterior moisture from entering building.

1.14 EQUIPMENT AND MATERIALS

A. Product Approvals:
   1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
   2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in specification.

B. Use domestic made pipe, pipe fittings and motors on project.

C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connection and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents.

D. Follow Manufacturer's directions in delivery, storage, protection and installation of equipment and materials.
   1. Promptly notify Architect in writing of conflicts between requirements of Contract Documents and manufacturer's directions and obtain Architect's written instructions before proceeding with work. Bear expenses arising from correcting deficiencies of work that do not comply with Manufacturer's directions or such written instructions from Architect.

E. Deliver equipment and material to site and tightly cover to protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

1.15 REVIEW OF MATERIALS AND EQUIPMENT

A. Furnish complete catalog data for manufactured items of equipment to be used in Work to Architect for review within 30 days after award of Contract.

B. Submit all mechanical items in (1) complete submittal. Provide an index of all items submitted, including specification section number, in the order they appear in the specifications.
   1. State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions and other pertinent information. Pertinent information shall include as a minimum those items as scheduled on the drawings. Arrange submittal information to reflect these categories scheduled on the drawings.
   2. Provide an index of tab numbers at the front of each binder. List the specification number and category included under each tab as described in the specifications and as scheduled on the drawings.
   3. Provide cover sheet for each tab section. List each piece of equipment by name, model number and supplier.
   4. Underline applicable data and indicate model being supplied on each submittal sheet.

C. If data is not submitted as specified or submittal is not complete, it will be returned without review.

D. Catalog data or shop drawings for equipment which are noted as being reviewed by the Architect, shall not supersede Contract Documents.

E. Review comments of Architect shall not relieve this Division from responsibility for deviations from Contract Documents unless Architect’s attention has been called to such deviations in writing at the time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

F. Check work described in catalog data with Contract Documents for deviations and errors.

1.16 OPERATIONS AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

A. Provide Operations & Maintenance Manuals for Mechanical Systems including:
   1. Provide a master index at beginning of Manual showing items included. Include name and phone number of nearest supplier and Manufacturer's representative. Use plastic tab indexes for sections of Manual.
   2. Step by step procedure to follow in putting each piece of mechanical equipment into operation.
   3. Provide schematic control diagrams for each separate fan system, refrigeration system, heating system, control panel, etc. Each diagram shall show locations of start-stop switches, insertion thermostats, room thermostats, thermometers, firestats, pressure gages, automatic valves and refrigeration accessories. Mark correct operating settings for each control instrument on these diagrams.
   4. Provide diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches and relays.
   5. Provide drawings of each temperature control panel identifying components on the panels and their function.

B. Maintenance instructions shall include:
   1. Manufacturer's maintenance instructions for each piece of mechanical equipment installed in project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operations instructions of equipment and maintenance and lubrication instructions.
   2. Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
   3. List of mechanical equipment used indicating name, model, serial number and nameplate data of each item together with number and name associated with each system item.

C. Air Balance and Test Run Reports.
   1. Include a copy of air balance reports and certifications.
   2. Include a copy of the 3-day operating test data.

D. Provide a complete set of approved shop drawing submittals as an Appendix item.

1.15 OPERATIONS AND MAINTENANCE INSTRUCTIONS

A. Instruct Owner/Owner's Representative in operation and maintenance of mechanical systems utilizing Operations and Maintenance Manual when so doing.

B. Minimum instruction periods shall be as follows:
   1. Mechanical – Sixteen (16) hours.
   2. Temperature Controls – Sixteen (16) hours.

C. Instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made.

D. None of these instructional periods shall overlap another.

1.18 GUARANTEE

A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or in the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

B. The Contractor shall, after completion of the original test of the installation, and acceptance of the Architect, provide any service incidental to the proper performance of the mechanical systems under guarantees outlined above for a period of one (1) year.

1.19 FINALLY

A. It is the intention that this specification shall provide a complete installation except as hereinbefore specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included.

B. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

PART 2 - PRODUCTS

2.01 ELECTRIC HEAT-TRACING SYSTEM

A. This specification covers the requirements for materials and support services for electric heat-tracing systems supplied by the vendor. Neither the supply of the materials related to the connection of the power supply nor the installation of the entire system is part of this specification.

B. The electric heat-tracing system shall conform to the specification. It shall be designed, manufactured, and tested in accordance with applicable requirements of the latest edition of the following codes and standards:

FM	Factory Mutual Research Corporation
IEEE 515	Institute of Electrical and Electronics Engineers
NEC	U.S. National Electrical Code (NFPA 70)
NEMA	National Electrical Manufacturers Association
UL 746B	Underwriters' Laboratories, Inc.
ANSI	American National Standards Institute
CSA	Canadian Standards Association

C. Cable shall be 120-volt, single phase, braided and jacketed, self-regulating cable for low temperature applications.

D. Cable construction shall be as follows:
   1. Buss Wires: Twin #16 AWG copper.
   2. Matrix: Semi-conductive polymer core whose electrical resistance varies with temperature.
   3. Jacket: Flame retardant insulation of thermoplastic.
   4. Braid: Tinned copper.
   5. Capacity: 5 watts per linear foot at 0 degrees F.

E. Control, Monitoring and Power Distribution Systems
   1. Provide a single point heat trace controller equal to Tracon GPT 130. Ground fault protection for up to 30 amps.

PART 3 - EXECUTION

Not Applicable.

END OF SECTION 23 05 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.02 RELATED SECTIONS

A. Section 23 07 19 - Piping Insulation.

1.03 REFERENCES

A. ASME B31.2 - Fuel Gas Piping

B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

1.04 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - Water:
1. Conform to ASME B31.9 and ASTM F708.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Hydronic Piping:
   1. Conform to ASME B31.9 and ASTM F708.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
   5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   6. Vertical Support: Steel riser clamp.
   7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.03 FLASHING

A. Metal Flashing: 28 gage 304 stainless steel.

B. Copper Flashing: 16 oz./sq. ft.

C. Lead Flashing:
   1. Waterproofing: 6 lb/sq ft.

D. Caps: Steel, 22 gage minimum; 16 gauge at fire resistant elements.

2.04 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.

C Sleeves for Ductwork and Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Coordinate exact size requirement for pads.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 4 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor drains watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

F. Seal attic penetrations.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blow-out. Fire stopping materials shall meet requirements of ASTM E119.

E. Install chrome plated steel escutcheons at finished surfaces.

3.06 SCHEDULES

HANGER ROD

PIPE SIZE Inches	MAX. HANGER SPACING Feet	DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8

END OF SECTION 23 05 29

PART 1 – GENERAL

1.01 SCOPE

A. The requirements for seismic protection measures to be applied to HVAC equipment specified herein are in addition to any other items called for in other sections of these specifications. The seismic protection shall conform to Design Category "C" (verify with structural drawings) of the 2021 Arkansas Fire Prevention Code.

B. Flexible pipe connectors.

C. Chiller connectors.

D. Pipe and equipment hangers and supports.

E. Equipment bases and supports.

F. Sleeves and seals.

1.02 REFERENCES

A. ASME B31.2 Fuel Gas Piping

B. ASTM F708 Design and Installation of Rigid Pipe Hangers.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 30 00 and Section 23 05 00.

B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 – PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hydronic Piping:
   1. Conform to ASME B31.9 and ASTM F708.
   2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable,

clevis.

4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Vertical Support: Steel riser clamp.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 ISOLATION MATERIALS AND SUPPORT UNITS

A. Flexible Pipe Connectors:
   1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
   2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.

B. Chiller Connectors:
   1. Provide Mason Industries Model MFDEJ Mason Flex Twin Sphere Connector.

2.05 SLEEVES

A. Sleeves for Pipes Thru Non-Fire Rated Floors: 18-gauge galvanized steel.

B. Sleeves for Pipes Thru Non-Fire Rated Beams, Walls, Footings, and Potentially

Wet Floors: Steel pipe.

C. Sleeves for Ductwork and Pipes Thru Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

D. Sleeves for Round Ductwork: Galvanized steel.

E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through bolt with recessed square steel plate and nut above slab.

3.03 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1 1/2-inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor

at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.04 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00. Refer to Structural Drawings for equipment pads. Coordinate exact size requirement for pads.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.

D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blowout.

E. Install chrome plated steel escutcheons at finished surfaces.

3.06 SCHEDULES

PIPE SIZE: MAX. HANGER SPACING		HANGER ROD DIAMETER
Inches	Feet	Inches
1/2 to 1 1/4	6.5	3/8
1 1/2 to 2	10	3/8
2 1/2 to 3	10	1/2
4 to 6	10	5/8
C.I. Bell and Spigot or No Hub and at Joints	5	

END OF SECTION 23 05 49

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling Tacks.

1.02 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit one (1) sample each of nameplate, pipe markers and ceiling tacks.

D. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.01 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.02 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

B. Chart: Typewritten letter size list in anodized aluminum frame.

2.03 PIPE MARKERS

A. Color: Conform to ASME A13.1

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow

direction arrow and identification of fluid being conveyed.

C. Lettering size shall be as described for stencils in the paragraph above.

D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Marker to be traceable.

2.04 CEILING TACKS

A. Description: Steel with 3/4-inch diameter color coded head.

B. Color code as follows:

1.	Yellow	-	HVAC equipment
2.	Red	-	Fire dampers/smoke dampers
3.	Green	-	Plumbing valves
4.	Blue	-	Heating/cooling valves

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners. Locate nameplates on service side of equipment or on front of equipment in a row. Locate nameplate inside access door on equipment exposed in finished rooms. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.

D. Identify control panels and major control components outside panels with plastic nameplates.

E. Nameplates shall include the following information:
1. Equipment mark noted on Drawings (i.e., AHU-1).
2. Area served (i.e., Conference Room).

F. Identify valves in main and branch piping with tags.

G. Identify piping, concealed above ceiling, with stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Identify piping exposed in Mechanical Rooms with plastic pipe markers. Secure

to piping in accordance with manufacturer's instructions. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side penetration of structure or enclosure, and at each obstruction.

J. Install underground pipe markers 6 to 8 inches below finished grade directly above pipe.

K. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Hydrostatic test of piping systems.

B. Testing, adjustment, and balancing of air systems.

C. Testing, adjustment, and balancing of hydronic systems.

D. System operating test.

1.02 RELATED SECTIONS

A. Common Work Results for HVAC - Section 23 05 00.

B. Automatic Temperature Controls - Section 23 09 23.

1.03 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

B. ASHRAE - 2007 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.

C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.04 SUBMITTALS

A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

B. Submit test reports as a submittal under provisions of Section 23 05 00.

C. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.

D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

E. Provide reports in hard back, letter size manuals, complete with index page and indexing tabs, with cover identification at front and side.

F. Include detailed procedures, agenda, sample report forms prior to commencing system balance.

1.05 QUALITY ASSURANCE

A. Mechanical contractor may at his option perform hydrostatic pressure test and hydronic balancing of the HVAC piping systems.

B. Air Balance Subcontractor shall be a qualified representative of the Air Distribution Manufacturer whose devices are used on the project, or a qualified Independent Balancing Contractor. Air Balance Subcontractor may not be the Mechanical Contractor or the Sheet Metal Contractor on the project.

C. In order to be considered qualified, the Air Distribution Manufacturer shall include with air device shop drawings evidence of qualifications as follows:
   1. Evidence of certification of calibration of equipment.

D. In order to be considered to be qualified, Independent Air Balance Contractor shall submit evidence of qualifications as follows:
   1. Evidence of certification of calibration of equipment.

1.06 SEQUENCING AND SCHEDULING

A. Plans for sequence of work.

B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. All measurements during air balance operations shall be made by means of the "Velometer" or "Anemometer" method. Instruments used for check of air quantities shall have recent certification of calibration.

B. The Air Balance Subcontractor shall furnish balance forms for all air systems. Forms shall list air distribution devices by location, system, size, pattern, CFM flow factor and required velocity.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:
   1. Equipment is operable and in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Correct fan rotation.
   7. Fire and volume dampers are in place and open.
   8. Coil fins have been cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.

11. Duct system leakage has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Correct pump rotation.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

3.02 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES

A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.

B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.04 ADJUSTING

A. Recorded data shall represent actually measured, or observed condition.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.05 HYDROSTATIC TEST

A. After completion of the installation, all piping shall be tested under 100 psi hydrostatic pressure, which shall be maintained for one hour without loss of pressure; after the system is proven tight and put in service, the contractor shall

perform the equipment start-up and operating tests. All equipment shall be placed in complete operating condition subject to the approval of the Engineer.

3.06 AIR BALANCE PROCEDURE

A. Provide air balance for all new air devices. At replacement units, balance unit to scheduled airflow. At replacement multi-zone units, balance zone ducts to CFM shown on zone schedules located on drawings.

B. All air quantities shall, after completion of the job, be adjusted to provide air quantities shown on plans. After complete adjustment, additional re-adjustment shall be performed if necessary to satisfy desired temperature.

C. The balance procedure shall include the checking of each supply, return and exhaust fan. As a minimum, CFM, RPM and ampere readings shall be taken. Pulley adjustments, etc., shall be performed to obtain the required CFM readings.

D. Air Balance Subcontractor shall also furnish all balancing instruments required. Air Balance Subcontractor shall provide one experienced technician to team with Contractor's technician to balance system. The Air Balance Subcontractor's Technician and the Contractor's Technician shall perform as a team during the entire field balancing operation.

E. After all adjustments and corrections have been performed to balance system as designed and required, the Air Balance Subcontractor shall prepare and submit three (3) copies of completed balance form to Architect/Engineer for approval.

E. At the time of balancing, the Air Balance Contractor's Technician shall verify that each device is the size and pattern submitted and includes accessories such as volume controls and deflectrols where specified.

G. Where project includes controlled Air Terminal Units, the Terminal Unit Manufacturer's Supplier shall be responsible for testing the automatic control devices on the Terminal.

3.07 SYSTEM OPERATING TEST

A. After the successful completion of all equipment start-up and individual item test requirements, formal tests shall be performed on the complete Mechanical systems, measurements shall be made and reports prepared as specified below. Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms. Submit for the Engineer's approval the form on which the measurements specified herein. Furnish all required record forms. Submit for the Engineer's approval, complete shop drawings or catalog data for all instruments to be used for the 3-day operating test, and obtain approval at least two weeks before the forms and instruments will be required. Sample forms can be provided by the Engineer if the Contractor requests.

B. First operating test by Contractor: Prove the operation of the Mechanical systems and of each individual item in the systems. At least 10 days' notice shall be given the Engineer of such tests. Should any item of the systems fail to perform in an approved manner, this test shall be repeated until the operating test is approved by

the Engineer. During this test, balance circulation of heating and chilled water, air and all other fluids conveyed to provide proper quantities to all items of equipment. Adjust and set all balancing cocks, valves, dampers and similar items to ensure that the systems perform as intended.

C. Checking by Owner and Engineer: Following the successful completion of first operating tests by the Contractor, the Owner and Engineer shall have the privilege of making such tests as they may desire during a period of three weeks to ascertain if any corrections are to be made to the system. At the end of the testing by the Owner and Engineer, the Engineer shall direct the Contractor in writing to make such corrections to the systems as are within the Scope of the contract.

D. Contractor's corrections to systems: Make all required corrections to the systems and notify the Engineer in writing that the corrections outlined have been completed and give at least seven days' notice of a final 3-day operating test.

E. Three-day operating test: An operating test shall then be performed by the Contractor to the satisfaction of the Engineer for a period of three days. Should any element of the systems not perform properly, the Contractor shall make all required corrections, and the test shall be repeated until successfully performed.

F. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the 3-day operating test.
1. Electrical: Running ampere and voltage of each motor 3/4 HP or larger.
2. Air pressures at entrance and exit of each electronic air cleaner, filter, coil, fan and damper.
3. Air temperatures in each heated or air-conditioned space, at the entrance and exit of each coil, downstream from each pair of dampers where air of two different temperatures is mixed and outside the structure.
4. Relative humidity at location of each humidity sensor.
5. Water pressures at each pump suction and discharge and at entrance and exit of each heating and cooling coil.
6. Water temperature at entrance and exit of each heating and cooling coil and the chiller and the outside air temperature for each chiller at the time of the water temperature readings. Include wet bulb air temperature.
7. Water temperature at entrance and exit of each boiler and the outside air temperature of each reading.

G. Report: Four copies of a written report of the 3-day operating test, on the approved form of record, shall be submitted to the Engineer for approval and subsequent transmittal to the Owner.

END OF SECTION 23 05 93

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for Duct Insulation for HVAC Systems.

1.02 RELATED SECTIONS

A. Section 23 3100 – HVAC Ducts and Casings.

1.03 REFERENCES

A. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

B. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

C. ASTM E96 - Water Vapor Transmission of Materials.

D. NFPA 255 - Surface Burning Characteristics of Building Materials.

E. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

F. Test standards and procedures for evaluating and a rating performance of fire-resistive and zero-inch clearance, duct wrap systems.
   1. Underwriters Laboratories Inc., (UL):
      a. UL 723, Surface Burning Characteristics per ASTM E 84.
      b. UL 1978, First Edition of the Standard for Grease Ducts.
      c. UL 1479, Through-Penetration Firestop Test.
   2. American Society for Testing and Materials (ASTM):
      a. E119, Standard Method of Fire Test of Building Construction and Materials; 2-hour External Total Engulfment Test.
      b. E814, Standard Method of Fire Tests of Through-Penetration Fire Stops.
   3. NFPA 96, 1994 Edition, Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 23 0500.

B. Product Data: Provide product description, list of materials, and thickness for each service, and locations.

C. Manufacturer's Installation Instructions: Indicate procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/100 per NFPA 255.

1.06 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 23 0500.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's density, and thickness.

C. Store insulation in the original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cement.

PART 2 - PRODUCTS

2.01 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553 and C612; flexible, non-combustible blanket.
   1. "K" value: 0.27 at 75 °F.
   2. Maximum service temperature: 250 °F.
   3. Maximum moisture absorption: 0.20 percent by volume.
   4. Density: 1.0 lb./cu ft.

B. Vapor Barrier Jacket:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture vapor transmission: 0.04 perm.
   3. Secure with adhesive and tape.

C. Vapor Barrier Tape
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with a pressure-sensitive rubber-based adhesive.

2.02 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, non-combustible blanket.
   1. "K" value: 0.24 at 75 °F.
   2. Maximum service temperature: 350 °F.
   3. Maximum moisture absorption: 0.20 percent by volume.
   4. Density: 4.2 lb./cu ft.

B. Vapor Barrier Jacket:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture vapor transmission: 0.04 perm.
   3. Secure with adhesive tape.

C. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with a pressure-sensitive rubber-based adhesive.

2.03 GLASS FIBER DUCT LINER, FLEXIBLE

A. Insulation: ASTM C553; flexible, bonded fibers, non-combustible blanket with edge coating.

1. "K" value: 0.26 at 75 °F.
2. Maximum service temperature: 250 °F.
3. Density: 1.5 lb./cu ft.

B. Adhesive:
1. Waterproof, fire-retardant type.

C. Liner Fasteners: Galvanized steel, the impact applied, or welded with a press on head conforming to Mechanical Fastener Standard MF-19/1.

2.04 FIRE-RATED DUCT INSULATION

A. A lightweight, non-asbestos, high-temperature inorganic foil encapsulated insulation blanket. Duct wrap system is used on commercial grease hood duct systems allowing a zero inch clearance to combustible construction and as a 2-hour fire-resistive rated enclosure system (shaft enclosure) when used with a listed or approved through-penetration system.

B. Performance Requirements:
1. Two-hour rated fire-resistive enclosure assembly, ASTM E119; Total Engulfment Test.
2. Class 1 interior finish materials, ASTM E84
3. Zero inch clearance to combustibles, maximum allowable surface temperatures on the unexposed side, UL 1978.
4. Three-hour, through-penetration protection systems for grease duct, ASTM E814, and UL 1479.

C. Materials
1. FlameChek™ Duct Insulation.
2. Tapes:
a. High-Performance Filament Tape: one-inch wide.
b. Aluminum Foil Tape: to seal cut edges of blankets.
3. Banding Material:
a. Minimum 1/2 inch wide, .015 inch thick, type 304-stainless steel.
4. Insulation Pins: 12-gauge, minimum 4-1/2 inches long, Type 300 series stainless steel, with 1-1/2 inch square or round speed clips.
5. Fire-stopping materials:
a. Mesh: 304 stainless steel, .011 inch thick, 12 inches wide
b. FlameChek™ Fiber Blanket
c. Unifrax FryePutty
6. Grease Duct Access Door, by duct fabricator:
a. Door Enclosure:
1) Steel angle opening frame.
2) Access door cover, no less than 16-gauge.
3) Insulation Pins.
4) Speed Clips.
b. Hardware:
1) Threaded rods: Minimum 4-1/2 inches long, 1/4 inch diameter galvanized steel with wing nuts and metal washers.

2) Steel tubing to fit over threaded rods, optional.
3) Wingnuts.

2.05 APPROVED MANUFACTURERS

A. Glass Fiber, Flexible:
1. Owens Corning Fiberglass, Type 100.
2. Johns Manville.
3. Architect Approved.

B. Glass Fiber, Rigid:
1. Owens Corning Fiberglass, Type 704.
2. Johns Manville.
3. Architect Approved.

C. Glass Fiber Duct Liner, Adjustable:
1. CertainTeed ToughGard 150.
2. Johns Manville.
3. Architect Approved.

D. Grease Duct Insulation
1. Flamechek Duct Insulation, CertainTeed Corporation.
2. Johns Manville.
3. Architect approved

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that ductwork has been tested and joints and seams sealed, before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials per the manufacturer's instructions.

B. Insulated ductwork conveying air below or above ambient temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate the entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Grease Duct
1. Apply two layers of FlameChek insulation with all seams and joints overlapped by 3 inches.
2. Off-set the longitudinal joint on the second layer by 10.5” from the first layer.
3. Secure the insulation to the duct using tape, SS bands, and insulation pins.
4. Follow all manufactures installation requirements for the installation of the insulation, transitions, hangers, access doors, and thru-penetrations.

D. Ducts exposed outside the building shall be externally insulated with 2” thick rigid glass

fiber insulation, and covered with a "peel and stick" membrane jacket system equal to "Alumguard" (50-60 mil thickness & .3 lbs./sf weight).

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE

DUCTWORK	THICKNESS
All supply, return and outside air ducts inside the building Unless noted otherwise.	2 inches
Dishwasher exhaust duct	2 inches

3.05 RIGID GLASS FIBER DUCTWORK INSULATION SCHEDULE

DUCTWORK	THICKNESS
All ductwork external to the building (See Section 3.02, Paragraph D)	2 inches

3.06 FLEXIBLE GLASS FIBER DUCT LINER INSULATION SCHEDULE

DUCTWORK	THICKNESS
Furnace Plenums & ductwork shown Cross-hatched on drawings.	1 inch

3.07 FIRE RATED DUCT INSULATION

	THICKNESS
Range hood exhaust ductwork (See Section 3.02, Paragraph C)	(2) 1½" layers

END OF SECTION 23 07 13

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for Piping Insulation for Heating, Ventilating, and Air Conditioning systems.

1.02 RELATED SECTIONS

A. Section 23 23 00 – Refrigerant.

1.03 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

E. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

F. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

H. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

I. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

J. ASTM E96 - Water Vapor Transmission of Materials.

1.04 SUBMITTALS

A. Submit under provisions of Division 01 and Section 23 05 00.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer's Installation Instructions: Indicate procedures which ensure

acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/100 or less in accordance with ASTM E84, NFPA 255, and UL 723.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 23 05 00.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

PART 2 - PRODUCTS

2.01 CELLULAR FOAM

A. Insulation: SASTM C534; flexible, cellular elastomeric, tubing.
   1. "K" Value: ASTM C177 C518; 0.27 at 75 degrees F.
   2. Minimum Service Temperature: -40 degrees F.
   3. Maximum Service Temperature: 220 degrees F.
   4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent pipe by volume, .0 percent sheet by volume.
   5. Moisture Vapor Transmission: ASTM E96, 0.20 perm inches.
   6. Maximum Flame Spread: ASTM E84; 25.
   7. Maximum Smoke Developed: ASTM E84; 25
   8. Connection: Waterproof vapor barrier adhesive.

2.02 APPROVED MANUFACTURERS

A. Cellular Foam:
   1. Armstrong Armaflex - FR.
   2. K-Flex USA.
   3. Architect Approved.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory applied or field applied.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
   3. Finish with glass cloth and vapor barrier adhesive.
   4. PVC fitting covers may be used.
   5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
   6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. For insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
   3. Finish with glass cloth and adhesive.
   4. PVC fitting covers may be used.
   5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
   6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

E. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert Location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

F. Finish insulation at supports, protrusions, and interruptions.

G. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or stainless-steel jacket with seams located on bottom side of horizontal piping.

H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

J. Valves and fittings insulated with block insulation shall be finished with insulating cement and troweled to a smooth and uniform finish.

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 REFRIGERANT PIPING

A. Refrigerant suction lines shall be insulated with ¾ inch thickness Armstrong FR/Armaflex, or approved equal, and shall be installed to manufacturer's recommendations. Joint butt joints with 520-adhesive. The insulation shall not be slit for installation.

B. All suction lines exposed to weather shall have two (2) coats of Armstrong aluminum cold storage paint applied directly to the Armaflex insulation surface.

3.05 ARMAFLEX INSULATION SCHEDULE

A.	Refrigerant Suction	¾ inch
B.	Humidity Drain (Interior)	½ inch

END OF SECTION 23 07 19

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Building Automation System (BAS), utilizing direct digital controls. (ASCENT)

1.02 RELATED WORK

A. Native BACnet-based system, with Microsoft Windows 10 compatible operator's workstation. Workstation, building controllers, application controllers, and input/output devices communicate using protocols and network standards per ANSI/ASHRAE Standard 135, BACnet. Workstations, controllers, and unitary controllers, to be native BACnet. Do not use gateways for controller communication. Gateways may be used to communicate with existing systems or systems installed under other sections.

1. BACnet-compliant hardware and software meeting system's functional specifications. Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system.
2. Individual hardware layouts, interconnection drawings, and software configuration from project design data.
3. Implement detailed design for analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
4. Design, provide, and install equipment cabinets, panels, data communication network cables needed, and associated hardware.
5. Interconnecting cables between supplied cabinets, application controllers, input/output devices, operator's terminals and peripheral devices (including but not limited to printers) supplied under this section.
6. Manufacturer's specifications for items supplied.
7. Specialists and technicians; assist installation, startup, and commissioning.
8. Operator and technician training program as described herein.
9. As-built documentation, operator's terminal software, diagrams, and associated project operational documentation (such as technical manuals) on approved media accurately representing the final system.
10. New sensors, dampers, valves, and new electronic actuators. No used components.
11. Owner will have full licensing and access rights for network management and operating workstation features for ongoing maintenance and operation of BMS.
12. BMS workstation will host graphic files for control system. Graphics and navigation schemes for project are to match any that are on existing site/campus.

1.03 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

B. Section 26 05 00 - Common Work Results for Electrical.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Products Supplied but Not Installed Under This Section:
   1. Control valves.
   2. Flow switches.
   3. Wells, sockets and inline hardware for water sensors (temperature, pressure, flow).
   4. Automatic control dampers, where not supplied with equipment.
   5. Airflow measuring stations.
   6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
   7. Variable frequency drives. (Does not include VFDs integral to chillers or boilers).

B. Products Installed but Not Supplied Under This Section: None.

C. Products Not Furnished or Installed but Integrated with the Work of This Section:
   1. Chiller control systems.
   2. Boiler control systems.
   3. Pump control packages.
   4. In-line meters (gas, water, power).
   5. Refrigerant monitors.
   6. Chemical water treatment.
   7. Smoke detectors (through alarm relay contacts).

D. Work Required Under Other Divisions Related to This Section:
   1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
   2. Provision and wiring of smoke detectors and devices relating to fire alarm system.
   3. Campus LAN (Ethernet) connection adjacent to Operator Workstation.

1.05 REFERENCES

A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

B. American National Standards Institute (ANSI): ANSI/ASHRAE Standard 135, BACnet.

C. Underwriters Laboratories:

1. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
2. UL 864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.

D. Electromagnetic Compatibility (EMC): EMC Directive 89/336/EEC (European CE Mark).

E. The Federal Communications Commission (FCC): FCC Part 15, Subpart J, Class A.

F. National Electrical Code (NEC).

1.06 SPECIFICATION NOMENCLATURE AND DEFINITIONS

A. Acronyms Used in this Specification:
1. ACM: Ascent Control Module.
2. Actuator: Device that opens or closes valve or damper in response to control signal.
3. AI: Analog Input.
4. AO: Analog Output.
5. Analog: Continuously variable state over stated range of values.
6. BAS: Building Automation System.
7. Compass: Alerton Workstation Software.
8. DDC: Direct Digital Control.
9. FC: Fail closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
10. FO: Fail open position of control device or actuator. Device moves to open position on loss of control signal or energy source.
11. GUI: Graphical User Interface.
12. HMI: Human Machine Interface.
13. HVAC: Heating, Ventilating and Air Conditioning.
14. LAN: Local Area Network.
15. MSDB - Microsoft SQL Database
16. Modulating: Movement of control device through a range of values, proportional to an infinitely variable input value.
17. Motorized: Control device with actuator.
18. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
19. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
20. Operator Workstation: PC running Compass software and any required software tools applicable for day-to-day operation of the BMS.
21. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.

22. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
23. PICS: BACnet Product Interoperability Compliance Statement.
24. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
25. Point: Analog or discrete instrument with addressable database value.
26. VLC: VisuaLogic Controller.
27. WAN: Wide Area Network.

1.07 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Construction details, layout, and location of control panels within building, including instrument location in panels and labelling. Indicate mechanical equipment associated with each controller and area in building being served by that equipment. For terminal unit control, a room schedule listing mechanical equipment tag, room number of space served, address of DDC controller, and pertinent information required for service.
1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Shop Drawings: Material details, construction, finish and adjacent construction relationship.
1. Engineering drawings, control sequence, and bill of materials for approval.
2. Standard Sizes for Drawings: 11 inches x 17 inches (ANSI B).
3. Eight complete physical sets of submittal drawings, and approved electronic media.

D. System Documentation: Include the following in submittal package.
1. System Configuration Diagrams: Simplified block format. Note software addressing for device communications for devices. Indicate locations of ethernet switches.
2. Input/output object listings and an alarm point summary listing.
3. Electrical drawings showing system internal and external connection points, terminal block layouts, and terminal identification.
4. Bill of materials, valve schedule, and damper schedule.
5. Instructions and drawings, for installation, operation, maintenance, preventive maintenance, troubleshooting, and spare parts for list control devices.

6. BACnet Protocol Implementation Conformance Statements (PICS) per ASHRAE Standard 135: For system elements-Operator's Workstations, building controllers, application controllers, routers, and repeaters.
7. Description and documentation of proprietary (non-BACnet) services and/or objects.

E. Project Management: Detailed project design and installation schedule with time markings and details for hardware items and software development phases.
1. Target dates for transmission of project information and documents. Indicate timing and dates for system installation, debugging, and commissioning.
2. Supply products to affected trades in time to prevent interruption of construction.
3. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified.
1. BAS System: Designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel.
2. Materials and Equipment: Latest standard design complying with requirements.
3. UL Listed under Standard UL 916, category PAZX: BAS peer-to-peer network controllers, central system controllers and local user displays.
4. Electronic Equipment: Conform to requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

B. Installer Qualifications: Experience with projects of similar scope and complexity.

C. Source Limitations: Each product type to be from a single manufacturing source.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products in environmental conditions outside recommended limits.
   1. If ambient conditions are not met at time of delivery, manufacturer reserves the right to void the warranty.

1.11 WARRANTY

A. Manufacturer's Warranty: Limited warranty against defects in materials and workmanship. Covers costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance and applies equally to hardware and software.
   1. Personnel supporting the hardware and software warranty agreement will provide on- or off-site service in a timely manner after failure notification. Acceptable Response Time: Within 24 hours, Monday through Friday; 48 hours on Saturday and Sunday.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Alerton.

B. Trane.

C. Johnson Controls.

D. Architect Approved.

2.02 SYSTEM DESCRIPTION

A. Except as indicated, system supplier to secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

B. BAS: Network of interoperable, stand-alone building controllers, field controllers on logical networks, graphics and programming for complete system.
   1. Password access to features, functions and data contained in BAS.
   2. Software for complete operating system, as specified, as integral part of supervisory controller. Not dependent upon higher level computer for execution.
   3. System Backup: Electronic copies of software, project graphics, setpoints, and system parameters. Backups will allow Owner to restore system if necessary.

C. Distributed Logic Control System: Software and hardware per ANSI/ASHRAE Standard 135.
   1. System controls mechanical equipment, including unitary equipment such as heat pumps, air handlers and listed equipment using native BACnet-compliant components.
   2. Operator's Workstation Software: BAS application written utilizing BACnet protocols. Software functions to include password protection, scheduling, alarming, logging of historical data, full graphics including animation, after-hours billing, demand limiting, and full suite of field engineering tools including graphical programming applications.
      a. Programming to make future changes to e system, controllers, field level devices, system changes, scheduling, and trending.
      b. Field engineering tools, graphical programming and applications.
   3. Building Controllers: Building management software, with scheduling building control strategies and optimum start and logging.
      a. Energy Management Software/Firmware: Resident in field hardware.
      b. Operator's Terminal Software: Used to access field-based building management functions. Zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
   4. Room Sensors: Viewable digital readout of room temperature, and outside air. Adjustable room setpoint within preset limits and set desired override time. Start and stop unit from digital sensor. Include wiring and firmware for field service mode allowing technicians to balance VAV zones and access parameters in zone controller directly from room sensor. Field service mode must have ability to be locked out.
   5. Application Controllers: Terminal units including VAV, HP and UV, air handler, central plant equipment, and other controlled equipment to be programmable. Mount next to controlled equipment. Communicate with building controller through BACnet LAN.

2.03 OPERATOR WORKSTATION (COMPASS UPGRADE REQUIRED TO EXISTING OPERATOR WORKSTATION)

A. Structure of Workstation Interaction: Client/server relationship. Embedded web server for browser access. Server to archive data and store system. Operator Workstations to support operation. Virtualized server environment. Web clients may access archive server data.
   1. Maximum Devices to be Connected: As indicated on Drawings.
   2. Not restrict system size based on point count (BACnet or Integration).

B. Operator Workstation: General purpose, commercially available, personal computer.
   1. Processor: Minimum speed of 2.5 GHz.
      a. Processor core as indicated on Drawings.

b. RAM: As indicated on Drawings.
c. Hard Drive: Minimum of 1 TB.
d. Provide more memory and/or a faster processor if necessary to perform the functions described in this specification.

C. Sufficient storage to accommodate fully configured point databases, application databases, graphics files, user-defined reports, and historical data archived as specified.

D. Graphic Based Displays: For each system.
1. Operator Workstation: Point data for each system. Update every 30 seconds.
2. Dynamically update data any action by user.
3. Graphic Displays: Iconic graphic representations of mechanical equipment. Display graphic files, text, trend-log, and dynamic object data displays including animation.
4. Graphic Displays: "Drill Down" capability from main display to more specific system displays or navigation tree for building equipment and system diagnostic centric display organization.
   a. Tree Navigation Contents: Customizable per-user and per-group basis.
5. Systems with Terminal Unit Controls: Building floor plan with dynamic temperatures, drillable for more specific terminal information.
6. Points on graphics allow user to change field-resident Operator Workstation functions associated with project, including setpoints, weekly and exception schedules, from any screen, whether screen shows text or graphic display. Do without reference to object addresses or other numeric/mnemonic indications.
7. Protect display views unless operator credentials have proper access level. Assign access levels to each display/system object. Menu labels not to appear on graphic if operator does not have appropriate security level.
8. Analog objects: Displayed with operator modifiable units. Input objects may be displayed as graphic items on display screen as an overlay to the system graphic.
9. Information: Labeled with descriptors and shown with appropriate engineering units.
10. DDCs system must provide graphic displays and files. Systems requiring graphics development or logic programming are prohibited. Graphic Files: JPG, GIF or PNG.
11. Submit graphic displays to Owner for review and approval. Approved graphics to be in place prior to commissioning.
12. Operator Workstation: Supply graphics library, to use unaltered or modified. Include library to assemble custom graphics. System to allow creation of new graphics.

13. Data Displays: Ability to link to content outside of BAS system. Content to include, but not limited to launching external files in their native applications.

E. General Requirements:
1. BACnet Conformance: Approved by BTL as meeting BACnet Building Controller requirements.
   a. Refer to ANSI/ASHREA 135, for a complete list of the services that must be directly supported to provide each of the functional groups listed above.
   b. Proprietary services, if used, document and provide as part of submittal data. Provide tools for working with proprietary information.
2. Scalable: Number of trunks and protocols selectable to fit project requirements
3. Capable of panel-mounting on DIN rail and/or mounting screws.
4. Global control strategies based on information from any objects in system, regardless if object is directly monitored by building controller module or by another controller.
5. Capable of running 6 independent control strategies simultaneously. Modification of one control strategy does not interrupt function or runtime others.
6. Software implementing DDC strategies to be completely flexible and user-definable.
7. Software Programming Tools: Provide as part of project software. Factory pre-programmed global strategies not modifiable by field personnel are not acceptable. Changing global strategies via firmware changes is also unacceptable.
8. Programming: Object-oriented control function blocks and support DDC functions. Flowcharts: Generated and automatically downloaded to controller. Programming tool to be resident on workstation. used same tool for controllers.
9. Graphically view inputs and outputs to each program block in real-time as program is executing. Function may be performed using operator's workstation or field computer.
10. Controller: 6,000 Analog Values and 6,000 Binary Values.
11. Controller IP configuration: Via direct USB connect or field computer.
12. Quad Core 996 Ghz processor to ensure fast processing speeds.
13. Execute control algorithms and automated control functions with 64-bit processor.
14. Minimum of 1 GB of DDR3 SDRAM on a 533 Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
15. Support 2 on-board EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus. Ports capable of supporting EIA-485 protocols including, to BACnet MS/TP and Modbus.

16. Support 2 ports-each of gigabit speed-Ethernet (10/100/1000) ports. Ports are capable of supporting Ethernet protocols including, BACnet IP, FOX, and Modbus.
17. Ports capable of having protocols assigned to utilize port's physical connection.
18. Minimum 4 onboard inputs, 2 universal inputs and 2 binary inputs.
19. Schedules:
    a. Normal seven-day scheduling, holiday scheduling and event scheduling.
    b. Support 380 BACnet Schedule Objects and 380 BACnet Calendar Objects.
20. Logging Capabilities:
    a. Log 2,000 objects at 15-minute intervals. Any object in system may be logged. Sample time interval adjustable at operator's workstation.
    b. Viewed logs on-site or off-site using WAN or remote communication.
    c. Periodically upload trended data to operator's workstation for archiving. Archived data available for use in spreadsheet or database programs.
21. Alarm Generation: Within the system for any object change of value or state, includes analog and binary object state changes, and controller communication failures.
    a. Each alarm may be dialed out as noted elsewhere.
    b. Provide alarm log for alarm viewing. Log may be viewed on-site at operator's terminal or off-site using remote communications.
    c. Handle up to 2,000 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
22. Demand Limiting of Energy: Built-in, user-configurable function.
    a. Controller modules support shedding up to 1,200 loads.
    b. Load shedding programs to operate as defined herein.
23. Tenant Activity Logging: Supported by a building controller module. Each independent module to support 380 zones.
    a. Tenant Activity logging to function as defined herein.

F. BACnet MS/TP:
1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4 Kbps
    a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum.
    b. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.

G. BACnet IP:

1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).
2. Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).
3. Each controller shall support at a minimum 128 BBMD entries.
4. BBMD management architecture shall support 3,000 subnets at a minimum.
5. Shall support BACnet Network Address Translation.
6. Proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. Necessary tools shall be supplied for working with proprietary information.

H. Expansion Ports:
1. Controller shall support two (2) expansion ports.
   a. Combining the two on-board EIA-458 ports with fully loaded expansion ports, the controller shall support six (6) EIA-485 trunks simultaneously.
2. Expansion Cards: Mate to the expansion ports, shall include the following.
   a. Dual port EIA-485 card.
   b. 78 kbps FTT10A LON network card.

I. Controller: Shall be in compliance with the following.
1. UL 916 for open energy management.
2. FCC Class B.
3. RoHS Compliant.
4. IEC 60703.
5. C-Tick Listed.
6. CE(EN 60730-1).

J. Controller: Operate in the following environmental conditions.
1. Without Battery: Minus 4 to 149 degrees F (Minus 20 to 65 degrees C).
2. With Battery: 32 to 122 degrees F (0 to 50 degrees C).
3. Relative Humidity: 0 to 95 percent, non-condensing.

2.04 ELECTRONIC CONTROL DEVICES

A. Temperature Sensors (Microset 4): Solid-state electronic, interchangeable with housing appropriate for application. Wall sensors: Install as indicated on drawings. Mount 48 inches (1219 mm) above finished floor. Duct sensors: Install so sensing element is in the main air stream. Immersion sensors: Install in wells. Immersion wells to be filled with thermal compound before installation of immersion sensors. Outside air sensors: Install away from exhaust or relief vents, not in an outside air intake, and in a shaded location.

2.05 ENCLOSURES

A. BAS Control equipment shall be provided and installed where shown on the associated HVAC Drawings and where needed for complete installation of BAS components. Coordinate mounting locations with other trades.

B. Controllers, power supplies and relays shall be mounted in enclosures. These items may also be mounted within the HVAC equipment control section if permitted by the HVAC equipment manufacturer, and if adequate space is provided.

C. Enclosures shall be designed for control and instrumentation applications, able to be mounted directly on the wall, and capable of adequately protecting the enclosed product in the environment in which it is mounted.

D. Enclosures shall not be mounted directly on HVAC equipment such as air handling unit housings. Enclosures shall be pedestal base or wall mounted.

E. Enclosures: NEMA 1 or as required by location and local code requirements when located in a clean, dry, indoor environment. Indoor enclosures: NEMA 12 or as required by location and local code requirements when installed in other than a clean environment. Outdoor Enclosures and Enclosures in Wet Ambient Conditions: Weatherproof.

F. Control Enclosures: Hinged doors, key lock latch; single key

G. Laminated plastic nameplates, 0.125 inches (3 mm) thick, for enclosures in any mechanical room or electrical room. Place location and unit served on easy to read nameplate.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Carefully inspect installed work of other trades. Verify work is complete to where work of this Section may commence.

B. Do not proceed with installation until substrates have been prepared using methods recommended by manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

C. If preparation is the responsibility of another installer, notify Architect and Owner’s representative in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.
   1. Install in conduit, wiring and cable, and install equipment in first-class manner, using proper tools, equipment, hangers, and supports, and in locations as required for a neat, attractive installations. No material shall be exposed if it is possible to conceal it. Exposed material shall be installed only with consent of the Engineer.
   2. Install the system as recommended by the manufacturer, using only equipment recommended or acceptable to the manufacturer.
   3. Support sensors as recommended by the manufacturer where inside equipment, such as ductwork. Sensors in the space shall be in small, attractive housings designed for that purpose and mounted on electrical junction box.
   4. Control tubing shall be supported at frequent intervals to support sagging. Tubing run in exposed areas shall be run in an inconspicuous manner following natural building lines. In finished portions of the building, tubing shall be run concealed.
   5. Use extreme care making connections to other equipment, such as boilers and chillers. Safeties of equipment are not to be by-passed or overridden by the BAS.
   6. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
   7. Install labels to identify control components.
   8. Provide equipment having moving parts and controlled by BAS with warning labels 2 inches (51 mm) in height, and in bright warning colors, stating equipment is remotely started by automatic controls. Post labels clearly in area of moving parts, including but not limited to belts, fans and pumps.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

A. Locate and install components for easy accessibility; in general, mount 48 inches (1219 mm) above floor with minimum 36 inches (914 mm) of clear access space in front of units. Obtain approval on locations from Owner's representative prior to installation.

B. Components including but not limited to instruments, switches, and transmitters; suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.

C. Identify equipment and panels. Provide permanently mounted tags for panels.

D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.04 INTERLOCKING AND CONTROL WIRING

A. Interlock and control wiring. Install wiring neatly and professionally, per Division 16 and national, state and local electrical codes.

B. Wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Shielded low capacitance wire for communications trunks.

C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of control equipment with the Owner's representative prior to rough-in.

D. Provide auxiliary pilot duty relays on motor starters as required for control function.

E. Provide power for control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.

F. Install control wiring in mechanical, electrical, telephone and boiler rooms in raceways. Install other wiring neatly and inconspicuously per local code. If code allows, control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit).

3.05 SOFTWARE

A. Load and debug software for BAS. Operate to prove functionality of each system.
   1. Provide database generation.
   2. System displays: Show analog and binary object types within system; logically laid out for easy use by Owner. Provide outside air temperature indication on system displays associated with economizer cycles.
   3. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
   4. Binary and analog object types (including zones) shall have the capability to be automatically trended.
   5. Analog inputs (High/Low Limits) and selected binary input alarm points to be prioritized and routed (locally or remotely) with alarm message per Owner's requirements.

B. BAS Contractor: Review programs with Engineer in the programming stage. Make sure programmer understands Engineer's intent and that program will carry out that intent.

C. Bound copy of the complete information on the equipment and components.

D. Spare parts list. Identify equipment critical to maintaining integrity of operating system.

3.06 SYSTEM DEMONSTRATION, VALIDATION AND ACCEPTANCE

A. Contractor will satisfactorily demonstrate operating sequence, daily and seasonal mode changes, and associated energy management routines for equipment controlled including:
   1. Hot water systems.
   2. Chilled water systems.
   3. Air handling units.
   4. Exhaust air systems.
   5. VAV terminal units.
   6. Miscellaneous Equipment: Including but not limited to the following.
      a. Ventilation systems.
      b. Cabinet heaters.
      c. Unit heaters.

B. Contractor to satisfactorily demonstrate proper operation of associated system points as defined in Division 15, including but not limited to:
   1. Analog input sensing device readings; temperature, humidity, pressure, flow, volume and CO2 sensors.
   2. Analog output controls; valves, dampers and speeds; including proper ranging.
   3. Binary input status readings.
   4. Binary output or two position controls; start/stops, open/closed, in/off.
   5. Pulsed inputs; flow meters, electric meters; including proper ranging.

C. Upon Completion of Work:
   1. Demonstrate complete operating system to Owner's representative.
   2. Certificate stating control system has been tested and adjusted for proper operation.

3.07 TRAINING

A. By BAS manufacturer. Utilize manuals, as-built documentation and on-line help utility.

B. Operator Training: Sixteen (16) hours encompassing, but not limited to the following topics.
   1. Sequence of operation review.
   2. Log in, log out.
   3. Password assignment and modification.
   4. Operator privileges assignment and modification.
   5. Selection of displays and reports.
   6. Commanding of points, including disable/enable.

7. Use of dialog boxes and menus.
8. Modifying warning limits, alarm limits and start-stop times.
9. Modification of color graphic displays.
10. Modification of alarm and status descriptors.
11. System initialization.
12. Backup, download and initialization of DDC in controllers.
13. Request and viewing of trend logs.
14. Archive and purge of historical data.
15. System maintenance procedures.

C. Programmer Training: Eight (8) hours encompassing but not limited to the following topics.
1. Software review of sequence of operation.
2. Use of programming tool and any additional plug-ins.
3. Modification of control programs, including Building Controller, Advanced Application and Application Specific programs.
4. Add, modify and delete data points.
5. Use of diagnostics.
6. System maintenance procedures.
7. Review of initialization.
8. Upload/download and off-line archiving of system software.
9. Creating and modifying color graphics
10. Operator training performed on site/off site. Coordinate dates/times with Owner.
11. Tuition for at least one individual to attend a one-week factory training class. If applicable, costs for travel, lodging and meals will be responsibility of Owner.
12. Printed training material provided by Contractor to training event attendees.

3.08 FIELD QUALITY CONTROL

A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

B. Manufacturer's Services: Coordinate manufacturer's services in accordance with appropriate sections in Division 01.

3.09 CLEANING AND PROTECTION

A. Clean and protect products in accordance with the manufacturer's recommendations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 23 09 23

PART 1 - GENERAL

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

1.02 SCOPE

A. Interconnecting piping between evaporator coil and condensing unit on split system packaged units.

B. Equipment condensate drains.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning System.

B. Section 23 07 19 – HVAC Piping Insulation.

PART 2 – PRODUCTS

2.01 PIPING

A. Type "L", hard drawn copper (degreased) – refrigerant piping.

B. Type “M” hard drawn copper – condensate drains

2.02 FITTINGS

A. Wrought copper.

2.03 SOLDER

A. Brazing alloy with 1000 degrees F melting point and suitable flux.

2.04 VALVES

A. Packless bellows or diaphragm type for use with Freon type refrigerant.

2.05 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper tubing: ASTM B88, Type M, hard drawn.
   1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.92 solder wrought copper.
   2. Joint: ASTM B32 solder, Grade 95TA.

2.06 APPROVED MANUFACTURERS

A. Valves:
   1. Mueller Brass Company.
   2. Architect approved equal.

B. Solder:
   1. Phoson Fifteen.
   2. Architect approved equal.

PART 3 – EXECUTION

3.01 Install refrigerant accessories as shown on the drawings and as may be recommended by the unit manufacturer.

3.02 Provide double suction risers and pitch lines as required to insure positive oil return to compressor.

3.03 Testing shall be done during progress of work or at completion to insure tight system. Change the system with dry nitrogen and soap test hot gas lines at 300 psi and liquid and suction lines at 245 psi. Allow system to stand for 24 hours under pressure and if change in pressure, system may be considered tight.

3.04 Before charging, evacuate the system to 0.15 inches of mercury absolute pressure. All pumps to operate at least four (4) hours at this reading.

3.05 REFRIGERANT CONTAINMENT

A. Contractor shall take all necessary precautions to prevent the accidental or intentional release of refrigerant to the atmosphere.

B. When a sealed system must be broken, provide all necessary equipment and containers as required to pump down the entire system volume, or that volume not contained in isolated receivers on the equipment.

C. Contractor shall clean and re-use refrigerant to the greatest extent possible. Un-used refrigerant shall be properly disposed of or recycled at the Contractor's expense.

3.06 Provide proper charge of refrigerant and oil for proper operation in accordance with manufacturer’s requirements.

3.07 Condensate drains for furnaces and cooling coils shall be combined and routed to floor drains. Route piping as required to not block access to unit.

3.08 Insulate all condensate drain piping inside the building.

3.09 Condensate drains from outdoor packaged units mounted on concrete pads, shall be piped to the edge of the slab in a manner as to not impede access to the unit.

END OF SECTION 23 23 00

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for HVAC Ducts and Casings.

1.02 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning System.

B. Section 23 05 93 – Testing, Adjusting and Balancing.

C. Section 23 07 13 – Duct Insulation.

1.03 QUALITY ASSURANCE

A. Installer: A firm with at least 3 years of successful installation experience on projects with low pressure ductwork systems work similar to that required for project.

B. SMACNA Standards: Comply with SMACNA HVAC Duct Construction Standards for fabrication and installation of low-pressure ductwork.

C. NFPA Compliance: Comply with ANSI/NFPA 9OA Standard for the Installation of Air-Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems" and ANSI/NFPA96 "Standard for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment".

D. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards", latest Edition.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork, used for work of this section.

B. Record Drawings: At project closeout, submit record drawings of installed ductwork, duct accessories, and outlets and inlets, in accordance with requirements of Division 01.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 PRODUCTS

2.01 LOW PRESSURE DUCTS

A. Ductwork Materials
   1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.
   2. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock forming quality, with ANSI/ASTM A 525, G9O zinc coating; mill phosphatized for exposed locations.

B. Miscellaneous Ductwork Materials
   1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
   2. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Hardcast tape or approved equal.
   3. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
      a. Except where space is indicated as "High Humidity" area, interior support materials of not less than l/4" diameter or 3/16" thickness may be plain (not galvanized).

C. Flexible Duct
   1. Flexible duct may be used in lengths not over 3'-0" to connect terminal units. Flexible duct shall not be used to turn elbows in excess of 45 degrees.
   2. Flexible duct shall meet U.L. 181 and conform to NFPA 9OA and 90B and be installed in accordance with the conditions of their listing by U.L. as a flexible duct.
   3. Installation shall conform to SMACNA "HVAC Duct Construction Standards", Section III, latest edition.

D. Fabrication
   1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
   2. Shop fabricated ductwork if gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards", First Edition, 1985.
   3. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius equal to associated duct width; and fabricate to including turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degree for contracting tapers and 20 degrees for expanding tapers. The contractor may use square 90 degree

elbows with turning vanes in lieu of centerline radius turns.

4. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Duct Accessories" for accessory requirements.

E. Factory-Fabricated Ductwork

1. General: As installer's option, provide factory- fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
2. Material: Galvanized sheet steel complying with ANSI/ASTM A 527, lock-forming quality, with ANSI/ASTM A 525, G90 zinc coating, mill phosphatized.
3. Gauge: 26 ga. minimum for round ducts and fittings, 4 inch through 24 inch diameter.
4. Elbows: One piece construction for 90 degree and 45 degree elbows 14 inches and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.
5. Divided Flow Fittings: 90 degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.
6. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:
   United Sheet Metal Div., United McGill Corp.
   Semco Manufacturing, Inc.
   Sheet Metal Products, Inc.

2.02 HIGH PRESSURE DUCTWORK

A. Ductwork Materials

1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.
2. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock forming quality, with ANSI/ASTM A 525, G90 zinc coating; mill phosphatized for exposed locations.
3. Ductwork constructed for positive pressure to 10”.

B. Miscellaneous Ductwork Materials

1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
2. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch take-off connections. Where 90 degree branches are indicated, provide conical type tees.
3. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
4. Duct Cement: Non-hardening migrating mastic or liquid neoprene based

cement (type applicable for fabrication/installation detail) as compounded by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

C. Fabrication

1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
2. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards.
3. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
4. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Duct Accessories" for accessory requirements.

D. Factory-Fabricated Ductwork

1. General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
2. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527 by the

Diameter	Minimum Gauge	Method of Manufacturer
3" to 14"	26 ga.	Spiral Lock seam
15" to 26"	24 ga.	Spiral Lock seam
27" to 36"	22 ga.	Spiral Lock seam
37" to 50"	20 ga.	Spiral Lock seam

   a. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.
   b. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seam.

Diameter	Minimum Gauge
3" to 36"	20
38" to 50"	18
Over 50"	16

3. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lock-seam construction, in minimum gauges listed.

Maximum Width	Minimum Gauge
Under 25"	24
25" to 48"	22
49" to 70"	20

Over 70"	18

a. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

Maximum Width	Minimum Gauge
Under 37"	20
37" to 50"	18
Over 50"	16

4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:

United Sheet Metal Div, United McGill Corp.
Semco Manufacturing, Inc.
Sheet Metal Products Co.

2.03 DUAL WALL DUCT AND FITTINGS

A. Dual wall duct shall be comprised of an airtight outer pressure shell, a 2 inch insulation layer, and perforated metal inner liner. Liner shall be supported from the steel by welded spacers. Where indicated on the drawings, ductwork shall have 3 inches of insulation for sound attenuation.

B. Insulation shall completely fill the space between the liner and outer shell and have the following UL ratings:

Flame Spread	10-20
Fuel Contributed	10-15
Smoke Developed	0-20

C. Outer shell of duct shall be minimum 20-gage galvanized steel. Inner liner of duct shall be minimum 28-gage galvanized steel.

D. Manufactured end fittings shall be installed at all connections of dual wall and single wall duct.

E. All round and oval ductwork shall be spiral lock seam pipe. The spiral pipe shall have been laboratory tested for leakage rate, friction loss, bursting and collapsing strength.

F. Fitting shall be of the standard machine-formed fittings as manufactured by the duct manufacturer. Fittings shall match those shown on the drawings as closely as possible. All fittings shall have a turning radius of 1-1/2 times the diameter of the duct where possible.

G. Provide “paint grip” finish where indicated on drawings.

2.04 DRYER VENTS

A. Dryer vent duct shall have smooth interior finish with joints running in direction of airflow.

B. Dryer vents shall not be assembled with sheet metal screws or other means which extend into the duct. Seal each joint with non-combustible material.

C. Provide vent cap with back draft damper and no screen. See detail on plans.

D. Provide Complete UL listed kit with everything needed to connect dryer to wall vent
- Close fit for 4-in wall clearance.
- 6-ft of flexible pipe.
- 2 close elbows resist crushing and maintain airflow.
- Swivel cuffs on close elbows allow moving dryer without disconnecting.
- Conforms to UL safety requirements.

PART 3 EXECUTION

3.01 LOW PRESSURE DUCTWORK

A. Installation of Ductwork

1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (1% leakage) and noiseless (no objectional noise) systems, capable for performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
2. Seal ductwork, to class recommended, and method prescribed in SMACNA "HVAC Duct Construction Standards", latest edition.
3. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
4. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct unusable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearances to 1/2 inch where furring is shown for enclosure of concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work. Do not locate ductwork over (parallel to) position indicated to extend to deck.
5. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and their electrical equipment spaces and enclosures.
6. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.
7. Provide insulated blank-off plates as indicated on the drawings where ducts

connect to vents or louvers.

8. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
9. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards", latest Edition.
10. Do not reroute or shorten branch ductwork to terminal or inline air devices without direct approval of design Engineer. Routings and offsets are designed to be in compliance with cross sectional area and distance from penetration through fire rated wall. Any changes must be in direct compliance with Section 510 of the Standard Mechanical Code, 1991 Edition.

B. Cleaning and Protection

1. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
2. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.02 HIGH PRESSURE DUCTWORK

A. Installation of Ductwork

1. General: Assembly and install ductwork in accordance with recognized industry practices which will achieve air tight (1% leakage) and noiseless (no objectional noise) systems, capable for performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
2. Seal ductwork, in accordance with recommendations of SMACNA "HVAC Duct Construction Standards - First Edition", 1985.
3. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
4. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearances to 1/2 inch where furring is shown for enclosure of concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
5. Electrical Equipment Space: Do not run ductwork through transformer vaults and their electrical equipment spaces and enclosures.
6. Where ducts pass through interior partitions and exterior walls, conceal

space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inch.

7. Provide insulated blank-off plates as indicated on the drawings where ducts connect to vents or louvers.
8. Refer to Division 23 - Duct Accessories Section for accessories required in conjunction with high-pressure ductwork. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
9. Support ductwork in manner complying with SMACNA "High Pressure Duct Standards - Latest Edition" hanging and supporting systems chapter.

B. Cleaning and Protection
1. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
2. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

C. Testing for Leakage
1. General: After each duct system is completed, test for duct leakage in accordance with SMACNA "High Pressure Duct Standards - Latest Edition, Chapter 10 - Testing and Leakage". Repair leaks and repeat tests until total leakage is less than 1% of system design air flow.

D. Balancing
1. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 31 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Volume control dampers.

B. Air turning devices.

C. Flexible duct connections.

D. Duct access doors.

E. Duct test holes.

F. Flexible elbow ductwork supports.

1.02 RELATED WORK

A. Common Work Results for HVAC - Section 23 05 00.

B. Ductwork - Section 23 31 00.

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - HVAC Metal Duct Standards.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

PART 2 - PRODUCTS

2.01 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Metal Duct Standards, and as indicated.

B. Provide end bearings.

C. Provide locking, indicating quadrant regulators on dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

D. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.02 AIR TURNING DEVICES

A. Multi-blade device with blades aligned in short dimension; steel or aluminum

construction; with individually adjustable blades, mounting straps.

2.03 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Metal Duct Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz. per sq. yd., approximately 6 inches wide, crimped into metal edging strip.

2.04 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Metal Duct Standards and as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one-inch-thick insulation with sheet metal cover.

D. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

E. Access doors with sheet metal screw fasteners are not acceptable.

2.05 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.06 FLEXIBLE ELBOW DUCTWORK SUPPORTS

A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible ductwork diameters 6 inches - 16 inches. Elbow supports shall be UL listed for use in return air plenum spaces.

B. Manufacturer: Subject to compliance with requirements, flexible ductwork elbow supports shall be:
   1. Thermaflex.
   2. Flexmaster.
   3. Approved equal.

C. Install flexible ductwork elbow supports at each diffuser, grille, or register, and elsewhere as indicated.

2.07 APPROVED MANUFACTURERS

A. Volume Control Dampers:
   1. United Air - Model EGS (ducts up to 8 inches deep)
   2. American Warming and Ventilating - Model VC-2 with on-blade linkage (ducts larger than 8 inches deep)
   3. Engineer Approved.

B. Duct Access Doors:
   1. Air Control Products.
   2. Ruskin.
   3. Engineer Approved.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.

C. Provide turning vanes for all square elbows.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

E. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 14 x 14-inch size for shoulder access, and as indicated.

F. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION 23 33 00

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: HVAC Power Ventilators
   1. Division 23 – All Sections
   2. Division 26 – All Sections

1.02 REFERENCES

A. Air Movement and Control Association Inc. (AMCA):
   1. 99 - Standards Handbook
   2. 200 - Publication, Air Systems
   3. 201-90 - Publication, Fans and Systems
   4. 202-88 - Publication, Troubleshooting
   5. 203-90 - Publication, Field Performance Measurement of Fan Systems
   6. 211-05 - Publication, Certified Ratings Program – Product Rating Manual for Fan Air Performance
   7. 300-96 - Standard Reverberant Room Method for Sound Testing of Fans
   8. 311-05 - Publication Certified Ratings Program – Product Rating Manual for Fan Sound Performance
   9. 99-0401-86 - Classification for Spark Resistant Construction
   10. 99-2408-69 - Operating Limits for Centrifugal Fans

B. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):
   1. 204-05 - Standard Balance Quality and Vibration Levels for Fans
   2. 210-99 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

C. American Society of Civil Engineers (ASCE):
   1. 7-02 - Minimum Design Loads for Building and Other Structures

D. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
   1. Chapter 45 - 2003 handbook, HVAC Applications
   2. Chapter 7 - 2001 Fundamentals handbook, Sound-Vibration
   3. Chapter 32 - 2001 Fundamentals handbook, Duct Design
   4. Chapter 18 - 1992 HVAC System and Equipment handbook, Fans

E. National Fire Protection Association (NFPA)
   1. 70 - National Electrical Code
   2. 90A-02 - Standard for the Installation of Air-Conditioning and Ventilating Systems
   3. 92A-06 - Recommend Practice for Smoke-Control System
   4. 92B-05 - Standard for Smoke Management System in Malls, Atria, and Large Areas
   5. 96-04 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

F. Occupational Safety and Health Administration (OSHA):
   1. 1910.212 - General requirements for Machine Guarding
   2. 1910.219 - General requirements for guarding safe use of mechanical power transmission apparatus
   3. 1926.300 - General requirements for safe operation and maintenance of hand and power tools

G. Underwriters Laboratories (UL):
   1. 507 - Electric Fans
   2. 555 - Fire Dampers
   3. 555S - Smoke Dampers
   4. 705 - Standard Power Ventilators
   5. 762 - Standard Power Roof Ventilators for Restaurant Exhaust Appliances
   6. 793 - Snow Load

1.03 SUBMITTALS

A. General: Submit in accordance with Section 01 33 00 Submittal Procedures

B. Provide dimensional drawings and product data on each fan.

C. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted.

D. Provide outlet velocity and fan's inlet sound power readings for the eight octave bands, decibels, and sones.

E. Strictly adhere to QUALITY ASSURANCE requirements as stated in section 1.04 of this specification.

F. Provide manufacturer's certification that exhaust fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance.

G. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams.

1.04 QUALITY ASSURANCE

A. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air and sound performance seal.

B. Classification for Spark Resistant Construction, levels A, B, and C conform to AMCA 99.

C. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3).

D. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.

E. The High Wind models have been analyzed and stamped by a state license P.E. to the ASCE 7-02 Standard which meets the IBC, Florida and Miami-Dade codes.

F. Each High Wind model is subject to be certified by a third party to the ASTM E330 Static Pressure Difference Standard.

G. All High Wind models have been analyzed using Computational Fluid Dynamics (CFD). The CFD simulates the flow of high speed (150MPH) winds over the surface of objects.

F. The Finite Element Analysis (FEA) is the results from the CFD and it can accurately predict the stress, strain, and deflection resulting from high wind loads.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation.

B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer’s instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual.

C. Handling: Handle and lift fans in accordance with the manufacturer’s instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

1.06 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
   1. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.
   2. Motor Warranty is warranted by the motor manufacturer for a period of one year. Should motors furnished by us prove defective during this period, they should be returned to the nearest authorized motor service station.

1.07 MAINTENANCE

A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Greenheck

B. Cook

C. Twin City

D. Architect Approved

2.02 DIRECT DRIVE ROOF DOWNBLAST CENTRIFUGAL EXHAUST FANS - GREENHECK MODEL G

A. General Description:
   1. Downblast fan shall be for roof mounted applications
   2. Performance capabilities up to 4,300 cubic feet per minute (cfm) and static pressure to 1 inches of water gauge
   3. Fans are available in sixteen sizes with nominal wheel diameters ranging from 8 inches through 18 inches (071 - 180 unit sizes)
   4. Maximum continuous operating temperature is 180 Fahrenheit (82.2 Celsius)
   5. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

B. Wheel:
   1. Constructed of aluminum
   2. Non-overloading, backward inclined centrifugal
   3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
   4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

C. Motors:
   1. AC Induction Motor
      a. Motor enclosures: Open driproof
      b. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase
      c. Mounted on vibration isolators, out of the airstream
      d. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants
      e. Accessible for maintenance

D. Housing:
   1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
   2. Shroud shall have an integral rolled bead for extra strength
   3. Shroud shall be drawn from a disc and direct air downward
   4. Lower windband shall have a formed edge for added strength
   5. Motor cover shall be drawn from a disc
   6. All housing components shall have final thicknesses equal to or greater then preformed thickness.
   7. Curb cap shall have pre-punched mounting holes to ensure correct attachment
   8. Rigid internal support structure
   9. Leak proof

E. Housing Supports and Drive Frame:
   1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators

F. Vibration Isolation:
   1. Rubber isolators
   2. Sized to match the weight of each fan

G. Disconnect Switches:
   1. NEMA rated: [1]
   2. Positive electrical shut-off
   3. Wired from fan motor to junction box installed within motor compartment

H. Options/Accessories:
   1. Birdscreen:
      a. Material Type: [Aluminum
      b. Protects fan discharge
   2. Roof Curbs:
      a. Types: Standing Seam Metal Roof Curb
      b. Mounted onto roof with fan
      c. Material: [Aluminum] [Galvanized]
      d. Insulation thickness: 1 inch
      e. Coating Type: None
   3. Curb Seal:
      a. Rubber seal between the fan and the roof curb
      b. Type: [Gravity]
      c. Prevents outside air from entering back into the building when fan is off
      d. Balanced for minimal resistance to flow
      e. Galvanized frames with pre-punched mounting holes
   4. Finishes:
      a. Types: None

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog installation instructions

3.02 EXAMINATION

A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected

3.03 PREPARATION

A. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance

B. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck. Install duct as specified in Air Distribution (Division 23)

3.04 INSTALLATION

A. Install fans system as indicated on the Installation, Operation and Maintenance Manual (IOM) and contract drawings

B. Install fans in accordance with manufacturer's instructions

3.05 SYSTEM STARTUP

A. Refer to Installation, Operation, and Maintenance Manual (IOM)

3.06 ADJUSTING

A. Adjust exhaust fans to function properly

B. Adjust Belt Tension

C. Lubricate bearings

D. Adjust drive for final system balancing

E. Check wheel overlap

3.07 CLEANING

A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

3.08 PROTECTION

A. Protect installed product and finished surfaces from damage during construction

B. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion

END OF SECTION 23 34 23

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for Air Terminal Units.

1.02 RELATED SECTIONS

A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.

B. Section 23 3100 – HVAC Ducts and Casings.

C. Section 23 0593 – Testing, Adjusting and Balancing.

1.03 REFERENCES

A. NFPA 90A - Installation of air conditioning and ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. ARI 880 - Air-Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals

D. ETL - Agency listing for air terminal unit construction and operation.

E. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized).

F. NFPA 90A, Lining.

1.04 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and radiated sound power levels (2nd through 7th octave bands) at design maximum operating conditions. Also submit Radiated Sound NC values.

C. Submit manufacturer's installation instructions.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.
B. Include manufacturer's descriptive literature, operating instructions, maintenance

and repair data.

C. Include directions for resetting all DDC controls.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years experience.

1.07 SYSTEM RESPONSIBILITY

A. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as "basis of design".

1.08 WARRANTY

A. Provide one year manufacturer's parts and labor warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General:
   1. Manufacturers must participate in the ARI Certification program. Unit performance data must be Rated in Accordance with ARI Standard 880, and must display the ARI Symbol on all standard units.

B. Specified Manufacturers:
   1. Price.
   2. Tuttle & Bailey, Inc.
   3. Titus
   4. Architect Approved.

2.02 SINGLE-DUCT TERMINAL UNITS

A. Basis of Design: Price Industries, Inc.
   1. Single-Duct Terminal Unit: SDV (direct digital controls).
   2. Quiet Single-Duct Terminal Unit: SDVQ (direct digital controls).
   3. Low Profile Single-Duct Terminal Unit: SDVLP (direct digital controls).

B. Performance Requirements:
   1. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. Sound ratings of air distribution assemblies.
   2. Use attenuation values found in AHRI 885 Appendix E.

C. General:

1. The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor.

2.03 SINGLE-DUCT TERMINAL UNITS, STANDARD AND LOW-PROFILE

A. Description:
   1. Furnish and install Price model [SDV], or [SDVLP] single duct terminal units in the sizes and configurations as indicated on the plans.

B. Unit Casing:
   1. The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch galvanized steel.
      a. The casing shall be assembled with longitudinal lock seam construction.
      b. Casing leakage shall be tested in accordance with ASHRAE 130.
      c. Casing leakage for the basic assembly shall not exceed 1.0 percent of the maximum rated airflow at 1.0 inches of water gauge.
      d. Casing leakage for the basic assembly shall not exceed 2.0 percent of the maximum rated airflow at 3.0 inches of water gauge.
      e. Low Profile terminals units [Price model SDVLP] shall have a maximum casing height of 10 inches.

C. Unit Discharge:
   1. Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.

D. Liners:
   1. Standard:
      a. Fiberglass Liner - FG.
         1) Insulation shall comply with the requirements of UL 181 (erosion), ASTM C1338 (fungi resistance), ASHRAE 62.1, and ASTM C1071, having a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
         2) The insulation shall be secured with adhesive.
         3) Insulation edges exposed to the airstream shall be coated with NFPA 90A approved sealant.
         4) Insulation thickness shall be (**select one**):
            a) 1/2 inch thick, R-value of 2.1.
            b) 3/4 inch thick, R-value of 3.2.
            c) 1 inch thick, R-value of 4.1.

E. Primary Air Damper Assembly:
   1. The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.
   2. The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.

3. The damper shaft shall be mounted on the [left], [right], [top], or [bottom] of the damper when looking in the direction of airflow.
4. The 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
5. Air leakage past the closed damper shall not exceed 2 percent of the unit maximum rated airflow at 3.0 inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.
6. The damper, seal, and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.

F. Airflow Sensor:
1. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures, and mounted to the inlet valve.
2. Plastic parts shall be fire-resistant, complying with UL 94.
3. The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Material containing polybrominated compounds shall not be acceptable.
4. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
5. The airflow sensor shall be furnished with twelve total pressure sensing ports and four static pressure sensing ports, and shall include a center averaging chamber that amplifies the sensed airflow signal.
6. After balancing, the airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

G. Inlet Valve - Standard:
1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
2. The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

H. Inlet Valve – Low Profile:
1. The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct for all units with inlet sizes four to eight inches in diameter. Inlets larger than eight inches in diameter shall be supplied as rectangular type inlets.
2. Round inlet valves shall include a 1/8 inch raised single bead weld for added strength.
3. The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
4. The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed and open positions.

I. Options:
1. Bottom Access Door:
a. The unit shall be supplied with a 4 inch x 6-3/4 inch bottom access door, secured to the casing with (**select one**):
1) Screws.
2) Snap latches.
3) Quarter turn sash latches.
2. Electric Heating Coil:
a. The electric heating coil shall be ETL listed to UL 1995 and CSA 22.2, and provided by the terminal unit manufacturer.
b. The electric coil casing shall be constructed from a minimum 20 gauge, 0.038 inch galvanized steel.
c. The heating elements shall be open wire nickel chrome construction, supported by ceramic insulators.
d. The integral control panel shall be a NEMA 250, Type 1 enclosure with hinged access door for access to all controls and safety devices.
e. The electric coils shall be provided with a primary automatic reset thermal cutout, a manual reset thermal cutout, and a differential pressure airflow switch for proof of airflow.
f. (Optional) The electric coils shall be provided with a non-fused door interlocking disconnect switch.
g. (Optional) The electric coils shall be provided with a silicon controlled rectifier (SCR) controller.
3. Control Transformers:
a. The terminal unit shall be supplied with a factory mounted 50 VA control transformer.

J. Electrical Requirements:
1. Single duct terminal units shall be provided with single-point power connection and disconnect switch.
2. The terminal unit equipment wiring shall comply with the requirements of NFPA 70.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as shown on the drawings.

3.02 INSTALLATION

A. Install the terminal units in accordance with the manufacturer's instructions.

B. Install the inlets of the air terminal units with the air flow sensors a minimum of three duct diameters from elbows, transitions, and duct takeoffs.

C. See drawings for the size(s) and duct location(s) of the air terminal units.

D. Provide ceiling access doors or locate units above easily removable ceiling components.

E. Support the terminal units individually from the structure.

F. Embed anchors in concrete in accordance with ASTM E488/E488M.

G. Do not support the terminal units from the ductwork.

H. Verify that electric power is available and of the correct characteristics.

3.03 ADJUSTING

A. Ensure the damper operator attached to the assembly allows full modulation of flow range from 100 percent of design flow to zero.

END OF SECTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Basic Requirements for Air Inlets and Outlets.

1.02 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning System.

B. Section 23 31 00 – HVAC Ducts and Casings.

C. Section 23 05 93 – Testing, Adjusting and Balancing.

1.03 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

C. ARI 650 - Air Outlets and Inlets.

D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - Low Pressure Duct Construction Standard.

1.04 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Air distribution devices have been specifically selected based on the specified manufacturer's performance data. If the Contractor submits on devices other than those specified, the submittal must include an item-by-item selection of substitutions listed by space location.

C. Where compliance with performance requires different dimensions, such as neck or face size, than the specified item, the submittal must note where these dimension changes occur listing both the original and the new dimensions.

D. Any additional costs by any trade resultant from air device substitution shall be borne by the Contractor.

1.05 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.06 SUBMITTALS

A. Submit product data under provisions of Division 01 and Section 23 05 00.

B. Submit schedule of air devices indicating type, size, location, and application.

C. Schedule must include model number, size, air pattern, CFM, pressure drop, throw, NC noise level, finish and mounting method for both the submitted and specified device.

D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

E. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 STANDARD AIR DEVICES

A. All standard air devices shall be equal to products scheduled on the Drawings.

2.02 LOUVERS (ALUMINUM)

A. Frame shall be 6-inch-deep channel of .081 inch thick 6063-T5 extruded aluminum alloy.

B. Blades shall be constructed of .081-inch-thick aluminum. Blades shall be adjustable and drainable.

C. Insect screen shall be aluminum mesh, removable type. Screen shall be mounted on exterior of louver.

D. Finish shall be as selected by Architect.

2.03 MAXIMUM SECURITY CEILING/SIDEWALL SUPPLY DIFFUSER (CD-3, RA-3, ER-3)

A. Maximum security sidewall/ceiling register with integral security bars. Manufacturer shall be Kees, Inc. Model SEG-9, or approved equal.

B. Diffuser shall have square face and square neck unless otherwise noted.

C. Face plate shall be constructed of 10-gauge, 3/16-inch steel with staggered 5/16-inch diameter holes on 7/16-inch centers with 1-1/2-inch flange. Provide 10-gage 3/16-inch steel sleeve and angles. Weld sleeve to diffuser and angles to sleeve where required.

D. Diffuser shall be provided with an opposed blade balancing damper, key operated from the face of the diffuser. (Provide square to round transition at connection to diffusers unless otherwise shown.)

E. Security bars shall be 7/8 inch diameter tool resistant steel double ribbed heat

treated to meet ASTM A627 and A629 tool resistant hardness. Bars shall be set in the sleeve in 2 inch wide by 1/2-inch-thick bars, which are in turn welded to the sleeve. Vertical bars shall be on 4-inch centers maximum, and horizontal bars shall be on 12-inch centers maximum. Bars shall be locked together at all crossings with heat-treated "Perma-Lock" clamps.

2.04 SECURITY CEILING SUPPLY DIFFUSER (CD-2)

A. Louver face diffuser with lattice faceplate and integral security bars. Manufacturer shall be Kees, Inc. Model SD, or approved equal.

B. Diffuser shall have square face and square neck unless otherwise noted. Size shall be as shown on the drawings. Pattern shall be 4-way, unless otherwise indicated on the drawings.

C. Face plate shall be constructed of 10 gage steel with 13/16 inch by 13/16-inch square holes and 3/16-inch frets. Provide countersunk bolt holes (1 at each corner) and 1 at the midpoint on each side of faceplate Provide tamperproof bolts and above ceiling angles with nutserts. Finish shall be as scheduled on the drawings.

D. Diffuser shall be provided with an opposed blade balancing damper, key operated from the face of the diffuser. (Provide square to round transition at connection to diffuser unless otherwise shown.)

E. Security bars shall be 7/8-inch diameter tool resistant steel double ribbed heat treated to meet ASTM A627 and A629 tool resistant hardness. Bars shall be set in the sleeve in 2 inch wide by 1/2-inch-thick bars, which are in turn welded to the sleeve. Vertical bars shall be on 4-inch centers maximum, and horizontal bars shall be on 12-inch centers maximum. Bars shall be locked together at all crossings with heat treated "Perma-Lock" clamps.

2.05 SECURITY CEILING RETURN AIR REGISTER (RA-2, ER-2)

A. Ceiling return air registers with integral security bars. Manufacturer shall be Kees, Inc. Model SEG-8, or approved equal.

B. Face plate shall be constructed of 10 gage steel 3/4 inch by 3/4-inch square holes with 1/4-inch fret, with 1-1/2 inch overlapping margin on all sides. Sleeve shall be constructed of 14 gage steel with continuously welded seams and welded to face plate. Provide 10-gage steel sleeve and angles. Weld sleeve to diffuser and angles to sleeve where required. Finish shall be as scheduled on the drawings.

C. Register shall be provided with an opposed blade balancing damper, key operated from the face of the diffuser.

D. Security bars shall be 7/8-inch diameter tool resistant steel double ribbed heat

treated to meet ASTM A627 and A629 tool resistant hardness. Bars shall be set in the sleeve in 2 inch wide by 1/2-inch-thick bars, which are in turn welded to the sleeve. Vertical bars shall be on 4-inch centers maximum, and horizontal bars shall be on 12-inch centers maximum. Bars shall be locked together at all crossings with heat treated "Perma-Lock" clamps.

2.06 SECURITY BARS AND GRATES

A. Security bars and grates shall be factory fabricated. Manufacturer shall be Kees, Inc. Model GR, or approved equal.

B. Frame styles shall be flat frame, sleeved with one (1) fixed and one (1) welded on angle or bent out flange for concrete block. Style shall be as shown on the drawings or as required at each location.

C. Sleeve shall be constructed of 10 gage steel. Security bars shall be 7/8-inch diameter tool resistant steel double ribbed heat treated to meet ASTM A627 and A629 tool resistant hardness. Bars shall be set in the sleeve in 2 inch wide by 1/2-inch-thick bars, which are in turn welded to the sleeve. Vertical bars shall be on 4-inch centers maximum, and horizontal bars shall be on 12-inch centers maximum. Bars shall be locked together at all crossings with heat treated "Perma-Lock" clamps.

2.07 APPROVED MANUFACTURERS

A. Air Devices
   1. Tuttle & Bailey.
   2. Price
   3. Metal Aire
   4. Architect Approved.

B. Louvers
   1. American Warming and Ventilating LE-31.
   2. Ruskin.
   3. Architect Approved.

C. Security Grilles
   1. Kees Inc.
   2. Price.
   3. Architect Approved.

PART 3 - EXECUTION

3.01 INSTALLATION (AIR DEVICES)

A. Install air devices in accordance with manufacturers' instructions.

B. Check location of air devices and make necessary adjustments in position to conform with architectural reflected ceiling plan, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Provide mounting frame or additional ceiling grid tees as required to mount air devices. Support devices as required to prevent ceiling sag.

3.02 INSTALLATION (LOUVERS)

A. Locate and place louver units plumb, level and in proper alignment with adjacent work.

B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joints fillers, as indicated.

D. Repair finishes damaged by installation operations. Restore finishes so that there is no evidence of corrective work. Return items which cannot be refinished in the field to the shop, make the required alterations and refinish the entire unit, or provide new unit, at contractor's option.

E. Protection non-ferrous 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.

F. Provide concealed gaskets, flashings, joint fillers, and insulations, and install as work progresses to make the installations weather-tight.

G. Field verify exact opening dimensions and coordinate mounting requirements with General Contractor.

END OF SECTION 23 37 00

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes units with integral heating and cooling for outdoor installation. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Integral heat source shall be Indirect Gas-Fired furnace. Integral cooling source shall be packaged DX. Airflow arrangement shall be Outdoor Air only. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in Section 2 of this specification.

B. Related Sections include the following:
   1. Section 23 09 23: Automatic Temperature Control.

1.02 SUBMITTALS

A. Product Data: For each type or model include the following:
   1. Complete fan performance curves for both Supply Air and Exhaust Air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
   2. Sound performance data for both Supply Air and Exhaust Air, as tested in an AMCA Certified chamber.
   3. Motor ratings, electrical characteristics and motor and fan accessories.
   4. Performance ratings for all chilled water or DX coils.
   5. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
   6. Estimated gross weight of each installed unit.
   7. Installation, Operating and Maintenance manual (IOM) for each model.
   8. Microprocessor Controller (DDC) specifications to include available options and operating protocols. Include complete data on all factory-supplied input devices.
   9. (Where applicable) Energy recovery performance data for both summer and winter operation.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.

B. For the actual fabrication, installation, and testing of work under this section, use

only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.

C. Product Options: Drawings must indicate size, profiles and dimensional requirements of unit and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".

D. End of line test with full report available upon request.

E. Certifications
   1. Entire unit shall be ETL Certified per U.L. 60335-2-40 and bear an ETL sticker.
   2. Energy Recovery Device shall be AHRI Certified, per Standard 1060.
   3. Coils shall be Recognized Components for ANSI/UL 1995, CAN / CSA C22.2 No 236.05.
   4. Indirect gas-fired furnace shall be ETL Certified as a component of the ERU. Indirect gas-fired furnace shall be an ETL Recognized Component of the ERU per ANSI Z83.8.

1.04 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each unit and associated plumbing and electrical systems.

B. Coordinate location of water system fittings to ensure correct positioning for connection to the water coil and condensate drain pipe.

C. Coordinate sequencing of construction of associated plumbing, HVAC, electrical supply.

1.05 WARRANTY

A. Full unit parts warranty including compressors (18 months standard, plus four (4) years extended equals five and a half (5.5) years.

B. Furnace HX Warranty – Twenty-five (25) years.

PART 2 - PRODUCTS

2.01 MANUFACTURES

A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:

1. Greenheck Fan Corporation
2. Valent
3. Architect Approved

2.02 MANUFACTURED UNITS

A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, exhaust air blower, energy wheel, hot gas reheat coil, indirect gas-fired furnace, packaged DX system, phase and brownout protection, motorized dampers, curb assembly, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power which have dual point power.

2.03 CABINET

A. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
   1. Unit's exterior shall be supplied from the manufacturer using G60 galvanneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours. Uncoated galvanized steel exterior is not acceptable.
   2. Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

B. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   1. Materials: Rigid urethane foam
      a. Thickness: 2 inch (50.8 mm)
      b. Thermal Resistance R13.
      c. Thermally broken.
      d. Meets UL94HF-1 flame requirements.
      e. Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
   2. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below:
      a. Thickness: 2 inch (50.8 mm)
      b. Thermal Resistance R8
      c. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.

d. Location and application: Divider panels between outdoor air and return air/exhaust air streams.

C. Roof Insulation: 2-inch (50.8 mm) fiberglass located above the 1-inch (25.4 mm) foam panel.

D. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18-gauge galvanized G90 steel or painted galvannealed steel.

E. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125-inch-thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.

F. Exhaust Air blower assemblies: (Energy Recovery Units only) Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125-inch -thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.

G. Evaporator Coil: Evaporator coil shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be a single circuit design. constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame.

H. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch.

I. Condensate drain pan: Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.

J. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.

K. Energy wheel: (Where applicable) Unit energy wheel shall be sized for the full

volume of outdoor and exhaust air without an energy wheel bypass damper(s). Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five-year warranty. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and is designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

L. Reheat coil shall be an all-aluminum micro channel design with factory installed modulating hot gas reheat valve.

M. Indirect gas furnace
1. Shall be ETL Certified as a component of the unit.
2. Shall have an integral combustion gas blower.
3. Shall be ETL Certified for installation downstream of a cooling coil.
4. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.
5. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.
6. Heat exchanger shall have a 25-year extended warranty.
7. Furnace control shall be HighTurndown 16:1 Modulating.
8. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly and exhaust blower.
9. Shall have solid state controls permitting stand-alone operation or control by building controllers.

N. Packaged DX System: Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. Condenser coils shall be all-aluminum micro channel design appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the unit's exterior. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. The lead refrigerant compressor shall be inverter hermetic scroll-type. Additional compressor shall be single stage

hermetic scroll-type paired in tandem with lead inverter compressor. Compressors shall be equipped with liquid line filter drier, electronic expansion valves (EEV) or thermostatic expansion valves (TXV) on non-inverter compressor circuits, manual reset high pressure and low-pressure cutouts and all appurtenant sensors, service ports, leak detection sensors and safety devices. Compressed refrigerant system shall be fully charged with R-454B refrigerant. Compressors shall be mounted within an insulated access compartment and on a raised cabinet shelf to reduce sound and vibration. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.

O. Condenser Fans: Fan blades must be constructed of aluminum or a composite material and have a geometry designed and documented to reduce sound and energy when compared to a traditional rectangular blade fan. Traditional rectangular blade fans are not allowed due to increased noise generated and increase power utilized. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. Single condenser fan running at max RPM and design static pressure shall not exceed an A-weighted sound power level of 75 db at free inlet/outlet test conditions

P. Packaged DX Control and Diagnostics: The Packaged DX system shall be controlled by an onboard digital controller (DDC) that indicates both owner-supplied settings and fault conditions that may occur. The DDC shall be programmed to indicate the following faults:
   1. Global alarm condition (active when there is at least one alarm)
   2. Supply Air Proving alarm
   3. Dirty Filter Alarm
   4. Compressor Trip alarm
   5. Compressor Locked Out alarm
   6. Supply Air Temperature Low Limit alarm
      a. Sensor #1 Out of Range (outside air temperature)
      b. Sensor #2 Out of Range (supply air temperature)
      c. Sensor #3 Out of Range (cold coil leaving air temperature)

Q. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.

R. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.

S. Curb Assembly:

1. (Roof Mounted Downflow): A curb assembly made of 14 gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit and shall have duct adapter(s) for supply air and return air. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly. The curb shall be the height of 14 in. Verify seismic requirements.
2. (Ground Mounted Downflow with horizontal duct): A curb assembly constructed of 14 ga. G90 galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit, be one piece having welded corners and shall have horizontal duct adapter(s) for supply air and return air. Curb assembly shall have double wall fully insulated plenum compartments (1", 1.5# density), including the bottom. Provide 1 ½" x ¼" closed cell gasketing as required. See drawings for curb height and duct sizes. Verify seismic requirements

T. Hail Guards: Protects the condensing unit from damage due to extreme weather conditions such as hail and flying debris.

2.04 BLOWER

A. Blower section construction, Supply Air: direct drive motor and blower shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.

B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

C. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.

D. Blades: Welded aluminum blades only

E. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.05 MOTORS

A. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.

B. Motors shall be 60-cycle, 3-phase 460 volts.

2.06 UNIT CONTROLS

A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.

B. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.

C. Unit supply fan shall be configured for Constant Volume (ON/OFF).

D. Unit exhaust fan shall be configured for Constant Volume (ON/OFF).

E. Outside Air / Return Air damper control shall be.

F. Dirty filter sensor shall be factory installed

G. Operating protocol: The DDC shall be factory-programmed for BACNet MSTP

H. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

I. (For units without Energy Recovery) Unit shall be provided with a space thermostat, measuring temperature and relative humidity. Thermostat shall have an LCD display and push buttons allowing for setpoint adjustment

2.07 FILTERS

A. Unit shall have permanent 2 inch (50.8 mm) aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8

disposable pleated filters shall be provided in the supply air stream. MERV 13 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.

B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.

C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.02 CONNECTIONS

A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.

B. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.

C. Duct installation and connection requirements are specified in Division 23 of this document.

D. Electrical installation requirements are specified in Division 26 of this document.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.05 START-UP SERVICE

A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.06 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training

END OF SECTION 23 74 13

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Electric Unit Heaters.

B. Electric Wall Heaters.

1.02 RELATED SECTIONS

A. Automatic Temperature Controls - Section 23 09 23.

B. Equipment Wiring Systems: Division 26.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. Submit shop drawings under provisions of Section 01 and Section 23 05 00.

B. Submit manufacturer's installation instructions.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01.

B. Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the site under provisions of Section 23 05 00.

B. Store and protect products under provisions of Section 23 05 00.

C. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

PART 2 – PRODUCTS

2.01 ELECTRIC UNIT HEATERS

A. Casing and Construction:
   1. Fabricated of die formed, heavy gauge steel and finished with two-tone, brown and beige, durable powder coated paint. Supply air is drawn through the rear heavy duty expanded steel inlet grill. Heated air is discharged through front adjustable louvers, which are spring loaded for individual adjustment. Made in U.S.A.

B. Mounting:
   Heaters are standard with a three-position mounting bracket for wall, ceiling or workbench. Heaters can be mounted for horizontal or vertical discharge. Note: Minimum mounting height is 6 feet, and minimum distance from side of heater to nearest wall is 6 inches. Note: Approved for residential applications.

C. Controls:
   1. The heater shall have a heavy-duty hydraulic thermostat (with a temperature range of 40 oF-110 oF) factory installed and wired. All controls and wiring shall be in a large wiring compartment with hinged door for easy access. An optional disconnect switch shall be available for field installation.

D. Thermal Overload:
   1. All heaters shall be equipped with an automatic reset thermal cutout to shut down the element and motor circuits if unsafe operating temperatures are exceeded.

E. Motor:
   1. Motor shall be totally enclosed, permanently lubricated, all angle industrial rated with thermal overload protection.

F. Wiring:
   Wiring to terminal block adjacent to incoming knockout in accordance with NEC and local codes.

G. Element:
   1. Heavy-duty block fin element design. The multiple tap electric connection design allows field conversion to eight wattage settings at 208/240-Volt single phase or 240/480 Volt, 3 phase. Units are available on special order with a specific wattage/voltage setting.

2.02 RADIANT CEILING PANEL HEATERS

A. Construction:
   1. Radiant Ceiling Panels shall be made of highest quality steel casing.
   2. Front panel shall be painted with textured powder coated finish.
   3. Electric Resistance element is fixed between dielectric material and insulation.

4. Two inches of insulation is compressed to one inch by back panel to minimize upward heat loss and radiant efficiency.
5. Radiant panels shall have 36" pre-wired flexible cable for easy installation and wiring connection.
6. CP Series is 20 gauge metal. Made in U.S.A.

B. Installation:]
1. CP Series shall be designated as 2x2 or 2x4 size. All panels are 1" thick.
2. The size shall be nominal dimension to be manufactured to fit drop ceiling systems. Standard units will fit regular "T" Bar frame.
3. For regular or trim line or other frame sizes, special construction is required.
4. RCP Series shall be used in recess mounting applications.
5. RCP Series shall be 2" less in width to recess between nominal 24" center ceiling joists.
6. RCP Series shall be complete with recess frame for finished construction.

C. Accessories:
1. Provide surface mounting frames for surface mounting the CP Series, and are Aluminum mill finish. Frames can be painted white to match panel.

D. Options:
1. Provide silicone sealed metal parts for high humidity applications.

2.03 MANUFACTURERS

A. Unit Heaters:
1. Markel.
2 Q-Mark.
3. Architect Approved.

B. Radiant Ceiling Panel Heaters:
1. Markel.
2. Q-Mark.
3. Architect Approved.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that required utilities are available, in a proper location, and ready for use.

3.02 INSTALLATION

A. Install per manufacturer's instructions.

B. Hang unit heaters from building structure, with pipe hangers anchored to building, not from the piping. Mount as high as possible to maintain the greatest headroom unless otherwise indicated.

C. Protect units with protective covers during the balance of construction.

3.03 CLEANING

A. Clean work under provisions Division 1.

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum the clean coils, and inside of cabinets.

C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by the manufacturer.

END OF SECTION 23 81 01

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Mini-split heat pump air handling unit. (AH-2,3,4,5)

B. Mini-split heat pump system outdoor unit. (HP-2,3,4,5)

1.02 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electric Code (NEC).

C. The system shall be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210/240 and bear the ARI label.

D. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

E. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2002 and installed to resist the wind pressures on the equipment and the supports.

F. The outdoor unit will be factory charged with R-410A.

G. A holding charge of dry nitrogen shall be provided in the evaporator.

H. System efficiency shall meet or exceed 16.0 SEER and 9.2 HSPF.

1.03 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 SINGLE ZONE WITH LGRED° HEAT PUMP INDOOR UNIT (DUCTED – VAHU)

A. Operating Conditions
   1. The indoor unit shall be capable of the following ambient operating range.
      a. Cooling: 57°F WB to 77°F WB
      b. Heating: 59°F DB to 81°F DB

B. General:
   1. Unit shall be manufactured by LG.
   2. Unit shall be factory assembled, wired, piped and run tested.
   3. Unit shall be designed to be installed for indoor application.
   4. Unit shall be designed to mount fully concealed behind the wall, in a closet or above the finished ceiling.
   5. The unit case shall be designed to accept an internal, optional LG electric strip heater mounted in the reheat position,
   6. The supply air shall be flanged for field installed ductwork that shall not exceed the

external static pressure limitation of the unit.
7. Unit shall bear the ETL mark.

C. Casing/Panel
1. Unit case shall be manufactured using 22-gauge Pre-Coated Metal (PCM).
2. The external surface shall be finished with a high gloss baked enamel finish.
3. The finish color shall be morning fog.
4. The cold surfaces of the unit shall be internally insulated with 1/2-inch foil faced polystyrene fiber insulation.
5. The inside surface of fan assembly door access panel shall be treated with 1/2-inch polystyrene fiber insulation, encapsulated on both sides.
6. The access panel shall be sealed along the edges with reinforced foil faced covering to prevent deterioration caused by panel removal.
7. All the access panels shall be provided with gasket seals to minimize air leakage.
8. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.

D. Cabinet Assembly
1. The unit shall be designed to operate in the vertical (up flow and down flow) configuration and horizontal (left and right) end discharge. Down flow configuration shall require an optional kit.
2. Unit shall, in the vertical position, have opening for supply air from top (or bottom) with a dedicated bottom (or top) vertical return and in the horizontal position supply air shall be from the left (or right) end with the return air from the right (or left) end.
3. The unit shall be designed to operate in the vertical (up flow and down flow) configuration and horizontal (left and right) end discharge. Down flow configuration shall require an optional kit.
    a. Unit shall, in the vertical position, have opening for supply air from top (or bottom) with a dedicated bottom (or top) vertical return and in the horizontal position supply air shall be from the left (or right) end with the return air from the right (or left) end.
4. Unit shall be equipped with factory installed temperature thermistors for:
    a. Return air
    b. Refrigerant entering coil
    c. Refrigerant leaving coil
5. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
6. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
7. Unit shall have the following functions as standard:
    a. Self-diagnostic function
    b. Auto changeover function (Single zone systems only)
    c. Auto operation function
    d. Dehumidifying function
    e. Child lock function
    f. Hot start
    g. Dual thermistor control
    h. Sleep mode
    i. External static pressure (ESP) control
    j. Aux heater applications

E. Fan Assembly:
1. The unit shall have an integral fan assembly consisting of galvanized steel housing and forward curve fan wheel.
2. The fan motor shall be Electronically Commutated Motor (ECM)

and Brushless Digitally (BLDC) commutated with permanently lubricated and sealed ball bearings.

3. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
4. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
5. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
6. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
7. The ECM fan shall adjust and deliver constant airflow regardless of permitted external static pressure.
8. The BLDC fan settings can be field adjusted from the factory setting (RPM/ESP)
   a. Unit manufactured starting October 2020, shall have Auto ESP Control to adjust and deliver constant airflow regardless of permitted external static pressure
9. The unit shall be designed for high-speed air volume against an external static pressure of up to 0.7" water gauge.
10. The unit shall be designed for high-speed air volume against an external static pressure of up to 1.0" water gauge.

F. Filter Assembly:
1. The unit shall be supplied with a filter rack capable of accepting a field supplied 16" x 20" x 1" filter cartridge and a filter rack capable of accepting a field supplied 24" x 20" x 1" filter cartridge.
2. The filter rack shall be equipped with guides to keep filter centered in the rack.
3. The filter access shall be from the front of the unit without removing coil or fan area access panel.
4. The filter access door shall be fitted with thumb screws that can be removed without the use of any tool.

G. Coil Assembly
1. Unit shall have a factory-built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have minimum two row coil, 18 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
5. Unit shall be designed for gravity drain.
6. The unit shall have a secondary drain port plug for overflow.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.

H. Microprocessor Control
1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. The unit shall be able to communicate with the outdoor unit using a field supplied minimum of 14 AWG, 4 conductor, stranded, shielded or unshielded power/communication cable. If shielded, it must be grounded to chassis at ODU only.
3. Central control shall be available through an optional control board for the outdoor unit.

4. Group control shall be available to allow multiple indoor units to operate from a single controller, or allow connection of more than one controller to an indoor unit.
5. The unit controls shall operate the indoor unit using one of the five operating modes:
    a. Auto operation
    b. Heating
    c. Cooling
    d. Dry
    e. Fan only
6. The units shall have provision for W-2 terminal connection for second stage heat.
7. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
8. The unit shall be able to operate with the fan turned off during system cooling thermal off.
9. The unit shall be able to operate with a continuous fan setting.

I. Electrical:
1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

J. Controls:
1. The indoor unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently.
2. An optional wireless handheld controller shall be available as an additional accessory for use with installed LG wired controller.
3. The indoor unit shall have a built-in interface for 3rd party thermostats.
4. The indoor unit shall accommodate an optional Wi-Fi module as an additional accessory to allow monitoring and control through a smart device with the LG Smart ThinQ© application.

K. Warranty
1. Please refer to the respective outdoor unit for applicable warranty.

2.02 SINGLE ZONE WITH LGRED° HEAT PUMP OUTDOOR UNIT (CASSETTE/DUCTED/VAHU)

A. Operating Conditions
1. The outdoor unit shall be capable of the following ambient operating range.
    a. Cooling: 5°F DB to 118°F DB
    b. Heating: -13°F WB to 64°F WB

B. General
1. Unit shall be manufactured by LG.
2. The air-conditioning system shall use R410A refrigerant.
3. Each system shall have one air source outdoor unit.
4. The refrigerant circuit shall be field piped to a single matching indoor unit to effectively and efficiently control the heating or cooling operation of the system.
5. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.
6. Factory installed microprocessor controls in the outdoor unit and indoor unit shall perform functions to efficiently operate the single zone system and communicate via minimum 14 AWG, 4 conductor, stranded, shielded or unshielded power/communication cable. If shielded, it must be grounded to chassis at ODU only.
7. The outdoor unit shall be internally assembled, wired and piped from the factory.
8. The factory assembled system shall have the outdoor unit fitted with refrigerant strainer, check valves, oil separator, accumulator, 4-way reversing valve, electronic expansion valve, high side and low side refrigerant charging ports, and a service port.

a. The outdoor unit shall include a sub cooler, vapor injection valve and vapor bypass circuit.

C. Piping capabilities
1. The outdoor unit shall be capable of operating at an elevation of 98.4 feet above or below the indoor unit.
2. The outdoor unit shall be capable of operating with up to 164 feet <LUU180HHV><LUU240HHV> or 246 feet <LUU360HHV><LUU420HHV>of total equivalent refrigerant piping length.

D. Defrost Operations
1. The outdoor unit shall be capable of auto defrost operation to melt accumulated ice off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.
2. Factory installed base pan heater shall be included for outdoor units.

E. Oil Management
1. The outdoor unit shall have an oil injection mechanism to ensure a consistent film of oil on all moving compressor parts at low speed.
2. The outdoor unit shall have an oil separator to separate oil mixed with the refrigerant gas during compression and return oil to the compressor.

F. Cabinet
1. The outdoor unit cabinet shall be made of pre-coated metal (PCM).
2. The front/side panels of the outdoor unit shall be removable type for access to internal components.
3. Outdoor unit cabinet shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

G. Fan Assembly
1. Each 1-1/2-to-2-ton outdoor unit shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a horizontal air discharge.
2. Each 3-to-4-ton outdoor unit shall be equipped with two direct drive variable speed propeller fans with BLDC motors with a horizontal air discharge.
3. The fan blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
4. The fan(s) shall be equipped with permanently lubricated bearings.
5. The fan motor(s) shall have variable speed to a maximum of 800 RPM.
6. The fan(s) shall have a raised guard to help prevent contact with moving parts.

H. Outdoor Coil
1. Variable Path Heat Exchanger
a. System shall have a variable flow path and outdoor heat exchanger function to vary the refrigerant flow volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the coil heat transfer capacity and efficiency.
b. The variable path heat exchanger technology shall be provided to maintain stable refrigeration cycle operation during mild weather conditions and maintain a robust hot vapor temperature system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at sub-zero outdoor air temperature down to minus (-) 13°F.
2. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.
3. Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.
4. The outdoor unit coil shall be factory tested to a pressure of 600 psig.
5. The coil for each outdoor unit shall have a minimum of 14 Fins per Inch (FPI).

6. The coil for each outdoor unit shall have a 2-row heat exchanger.
7. The outdoor unit cabinet shall have a coil guard.

I. Compressor
1. The outdoor unit shall be equipped with one hermetically sealed, digitally controlled, inverter driven R1 scroll compressor.
2. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 10 Hz to 95 Hz (cooling), 10Hz to 130Hz (heating), with control in 1 Hz increments.
3. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 15 Hz to 120 Hz (cooling), 15Hz to 135Hz (heating) with control in 1 Hz increments.
4. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 10 Hz to 120 Hz (cooling), 10Hz to 135Hz (heating), with control in 1 Hz increments.
5. The outdoor unit shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.
6. The compressor shall be mounted on vibration attenuating rubber grommets.
7. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
8. The compressor bearing(s) shall have Teflon™ coating.
9. The compressor shall be equipped with over-current protection.
10. Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.

J. Sound Levels
1. The outdoor unit shall have sound levels not exceeding 56 dB(A) tested in an anechoic chamber under ISO 3745 standard.
2. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.

K. Sensors
1. The outdoor unit shall have
   a. Suction temperature sensor
   b. Discharge temperature sensor
   c. High pressure sensor
   d. Low Pressure sensor
   e. Outdoor temperature sensor
   f. Outdoor unit heat exchanger temperature sensor
   g. Vapor injection inlet temperature sensor
   h. Vapor injection outlet temperature sensor

L. Wind Load Installations for Outdoor Units
1. Provide Florida wind Load Installation Drawings that meet the requirements of the 2017 Florida Building Code, 6th Edition and ASCE Standard 7-2010 with submittal.

M. Warranty
1. Limited Warranty Period
   a. STANDARD FIVE (5) YEAR WARRANTY FOR A QUALIFIED SYSTEM - The Part(s) of a qualified System, including the compressor, are warranted for a period (the “Standard Parts Warranty Period”) ending five (5) years after the date of original installation. In absence of proof of installation, the warranty date will end five (5) years from the date of manufacture.

b. ADDITIONAL TWO (2) YEAR COMPRESSOR PART WARRANTY - The Compressor is warranted for an additional two (2) year period after the end of the applicable Standard Part Warranty Period (the "Compressor Warranty Period").

2. Extended Warranty

a. The Standard Warranty Period and the Compressor Warranty Period are extended to a total of ten (10) years (the "Extended Warranty Period") for qualified Systems that have been (a) installed by a party that has completed the Training Requirements, (b) installation is pursuant to LG's published instructions, and (c) product is registered within 60 days of startup at www.lg-dfs.com or www.lg-dfs-warranty.com.

2.03 APPROVED MANUDFACTURERS

A. LG

B. Daikin

C. Mitsubishi

D. Architect Approved.

PART 3 – EXECUTION

3.01 Orient unit to obtain maximum air flow to condenser coil and adequate clearance for service (refer to manufacturer's installation instructions.

3.02 Install unit level and attach to supports.

3.03 Install interconnecting refrigerant piping between outdoor unit and indoor air handler. Arrange piping to provide access for service panel removal and to avoid restricting service walk area.

3.04 Coordinate location of electrical connections with electrical contractor.

3.05 Install condensate drain piping.

3.06 Install control wiring in conduit.

3.07 Install unit identification tags.

3.08 Secure outdoor units to concrete base.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electric radiant floor heating cables installed in concrete slab.

B. Cable strapping for in-slab installation.

C. Digital thermostat with remote underfloor sensor.

D. Electric in-slab radiant floor heating system components, accessories, and associated installation materials.

1.02 REFERENCES

A. National Electrical Code (NEC)

B. Underwriter's Laboratory (UL)

C. Radiant Panel Association (RPA)

D. American National Standards Institute (ANSI)

1.03 PERFORMANCE REQUIREMENTS

A. Electric floor heating must generate 12 watts per square foot.

B. Heating cables and cable strapping must be designed for imbedding in concrete slabs.

C. Reference contract drawings for wiring layout and details.

1.04 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Provide General Contractor, Architect, MEP Engineer, and Owner with all the manufacturer's product data sheets, warranty, and installation instructions.

C. Provide General Contractor, Architect, MEP Engineer, and Owner with all relevant Shop Drawings, Samples, Mock---Ups, and Electrical Schematics.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications & Services:
   1. Experience with electric radiant floor heating systems.
   2. Floor heating mats, thermostats, sensors, relays, and related items shall be provided by one manufacturer.
   3. Must provide technical installation support, and free design assistance.

B. Installer Qualifications:
   1. A licensed electrician shall complete all electrical rough/ in, and electrical connections required to complete the system installation.

C. Pre/ Installation Meetings:
   1. Coordinate work with other trade representatives (general, electrical, flooring, and other trade contractors) to verify areas of responsibility (scope of work).
   2. Review project timeline and construction deadlines to ensure project will comply with all manufacturer's installation instructions and warranty requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials protected from exposure to harmful site conditions, and in an area protected from vandalism and theft.

1.07 WARRANTY

A. Heat cables to be warranted for 10 years from date of purchase, provided the product is installed per manufacturer's guidelines.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. ThermoSoft PH: 866-913-7883
701 CORPORATE WOOD PKWY
VERNON HILLS, IL 60061
Web: www.us.thermosoft.com Email: info@thermosoft.com

B. Substitution requests must be approved 15 days prior to bid due date. Alternative equipment manufacturer must provide all relevant product data sheets, warranty, installation instructions, shop drawings, samples, and electrical schematics. Alternative equipment must meet specified material standards.

2.02 CABLE SPECIFICATIONS

A. Cable Construction: Twin conductor, emits zero EMF, single point connection.

B. Rated Voltage: 120V, 240V

C. Output: 6 watts per linear foot

D. Cable Length: 55’ to 680’

E. Bending Radius: 1.5”

F. Cable Diameter: ¼”

G. Conductor Insulation: Fluoropolymer and XLPE

H. Outer Insulation: PVC

I. Maximum Rated Temperature: 220°F (105°C)

J. Minimum Installation Temperature: 40°F (105°C)

K. Cold Lead: 20ft.

2.03 THERMOSTAT AND ACCESSORIES

A. Provide electronic ON/OFF thermostat with control of temperature by means of an NTC sensor. Include red LED light to indicate when heating is on. Thermostat to have wide temperature range with gravitated scale measured in degrees Fahrenheit. Thermostat to be 120/240V AC, 60 Hz and meet UL8730-1 and UL8730-2.9 standards for temperature indicating and regulating equipment.

B. Provide in-floor sensor with 10ft. lead wire (extendable with 20 awg wire.)

PART 3 - EXECUTION

3.01 MANUFACTURER’S INSTRUCTIONS

A. Comply with manufacturer’s product data, including product technical bulletins, installation instructions and design drawings.

3.02 EXAMINATION & PREPARATION

A. Installer shall verify field measurements are as shown on Shop Drawings(s).

B. Any revisions needed to Shop Drawings, or product provided, must be corrected

prior to proceeding with the installation.

C. Prepare your subfloor, as per the standard guidelines.

.

D. Installer shall verify that the required power, is available, in proper location, and ready for use.

3.03 INSTALLATION

A. Complete installation must conform to appropriate manufacturer's installation instructions, National Electrical Code, and appropriate local codes.

3.04 FIELD QUALITY CONTROL

A. Test each heater for ohms, with a digital OHM meter before and after the installation. Record these values on the warranty form or start-up report.

B. Start/up (first/time activation) may proceed immediately after testing.

C. During "Start/Up", voltage and amps should be tested by a licensed electrician.

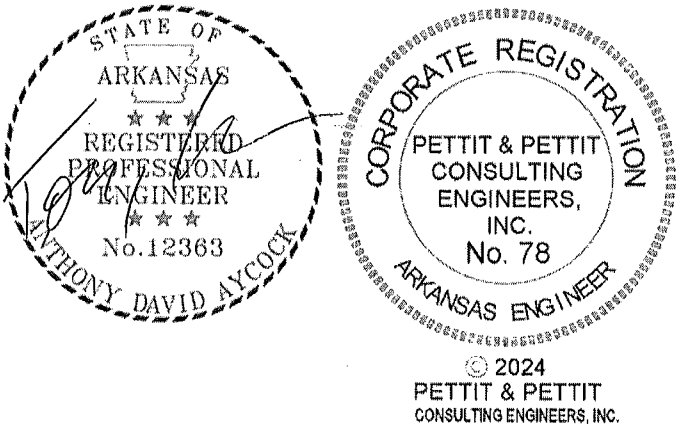
D. All testing records should be copied, and provided to the Owner.

END OF SECTION 23 83 13

The Engineer of Record for Divisions 26, 27, and 28 of the Specifications for the Little Rock Zoo, Entry Habitats Renovation Project, Little Rock, Arkansas (P & P Job No. 24-027) is:

12-20-24

Date



PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Divisions 26, 27, and 28 Sections, in addition to Division 1 - General Requirements.

1.02 REFERENCES

A. The following specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:
   1. American Society for Testing Materials.
   2. American Standards Association.
   3. Americans with Disabilities Act (ADA).
   4. Arkansas Energy Code (ASHRAE 90.1).
   5. Arkansas Fire Prevention Code.
   6. Illuminating Engineering Society.
   7. Institute of Electrical and Electronic Engineers.
   8. International Building Code, 2012 Edition.
   9. Local, City and State Codes and Ordinances.
   10. National Electrical Code, 2014 Edition.
   11. National Electrical Manufacturers Association.
   12. National Electrical Safety Code, 2012 Edition.
   13. National Fire Protection Association's Recommended Practices.
   14. Occupational Safety and Health Act.
   15. Power Cable Engineers Association.
   16. Service requirements of serving utility company.
   17. Underwriter's Laboratories, Inc.

1.03 SUBMITTALS

A. Submit six (6) sets of shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal. The basic information for each item of equipment to be included is as follows:
   1. Index.
   2. Installation and Operating Instructions
      a. Individual tabbed sections.
      b. Manufacturer descriptive literature.
      c. Applicable control diagrams.
      d. Composite wiring diagrams.
   3. Each submittal sheet shall be clearly marked with equipment Catalog Number and accessory items being submitted.

1.04 REGULATORY REQUIREMENTS

A. Work shall conform to all applicable codes, specifications, local ordinances, industry standards and utility company regulations.

B. Notwithstanding any reference in the specifications to any article, device, product,

material, fixture, form or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor, in such cases, may at his option propose any article, approved equal to or better than that specified, as approved in writing by the Engineer.

C. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.

D. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.

E. Non-Compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

F. All required fees, permits and inspections shall be obtained and paid for by the contractor under the section of the specifications for which they are required.

1.05 ELECTRICAL LICENSE REQUIREMENT

A. No person shall perform electrical work on the Contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiner's Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one-to-one ratio.

B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

C. The Arkansas Department of Labor requires that the worker, who installs raceway for low voltage cables of temperature controls, fire alarm, telecommunications, intrusion detection, access control, public address, television distribution, etc., be paid the electrician’s minimum wage rate.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Engineer/Owner reserves the right to relocate any device a maximum distance of 6'-0" at the time of installation without an extra cost being incurred.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.07 CONTRACTOR REVISED DRAWINGS

A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during

the progress of the job.

B. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Engineer, one set of "contractor revised" reproducibles, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.

1.08 GUARANTEE

A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of one (1) year.

1.09 OPERATING AND MAINTENANCE MANUALS

A. After approval of materials and equipment for use in this project, 3 copies of an Operation and Maintenance Manual shall be submitted for approval.

B. The basic information for each item of equipment to be included is as follows:
   1. Index
   2. Maintenance and operating instructions
      a. Manufacturer's descriptive literature and maintenance manuals
      b. An Approved Set of Shop drawings
      c. Applicable control diagrams
      d. Composite wiring diagrams as applicable showing all motor controllers, relays, etc., with interlocking provisions as built in the job, along with a written description of the control sequence if applicable.
      e. Spare parts list (when parts are provided)
      f. Listing of part suppliers and their addresses
      g. Single line diagram of the "as built" building electrical distribution system.

C. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Engineer and hold two (2) copies for instruction of Owner as hereinafter specified.

1.10 CONFLICTS BETWEEN DRAWINGS AND SPECIFICATIONS

A. If a conflict between the drawings and the specifications occurs, the most stringent requirement shall apply.

PART 2 - PRODUCTS

2.01 UL LISTING

A. Where the Underwriter's Laboratories have an applicable standard, the product

shall be listed with UL and shall be so marked.

2.02 SUBSTITUTIONS

A. Each Section of the Project Manual, when applicable has a paragraph entitled "Manufacturers". If "Engineer Approved Equal" is not in the list of manufacturers, no substitutions will be accepted. Submit one of the manufacturers listed.

B. The Engineer does not give any prior approvals on submittals. Do not call the Engineer for prior approval.

PART 3 - EXECUTION

3.01 600 VOLT INSULATION TEST

A. Prior to energizing the electrical system, the contractor shall provide insulation resistance tests for all distribution and utilization equipment. The Contractor shall provide a suitable and stable source of test power. The insulation test shall be a "megger" test at 500 volts D.C. for one-half minute. A test report shall be submitted to the Engineer. The minimum insulation resistance for No. 12 AWG conductors shall be 1,000,000 ohms and for larger conductors shall be 250,000 ohms. Conductors testing below the minimum insulation resistance shall be replaced and tested again.

3.02 CONTINUITY TEST

A. The Contractor shall perform a continuity test on the entire electrical system prior to energizing the system to insure proper cable connections.

3.03 CONNECTION TORQUE TESTS

A. All No. 1/0 AWG and larger conductors with bolted connections shall be torque tested using a torque wrench. Torque shall be to National Electrical Testing Association's (NETA) Standards.

3.04 REMOVAL OF RUBBISH

A. Contractor shall remove his rubbish from building site at intervals and shall maintain the spaces allotted him in an orderly manner. On completing his work, and prior to submission of final estimate, he shall remove all tools, appliances, material and rubbish from the grounds.

3.05 GROUND RESISTANCE MEASUREMENTS

A. Ground resistance measurements of each ground rod shall be taken and certified by the Contractor to the Engineer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Engineer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground of part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground resistance measurements shall be made in normally dry weather, not less than 48

hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE No. 142. Submit test reports with Operation and Maintenance Manuals.

3.06 MECHANICAL OPERATION TESTS

A. All electrical equipment, such as switches, circuit breakers, etc., shall be tested by operating the device to verify that the mechanical portions of the device are functioning.

3.07 ROTATIONAL TESTS

A. The Contractor shall assist Division 26 in performing rotational tests on all motors. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.

3.08 INSTRUCTING OWNER'S REPRESENTATIVE

A. The Contractor shall instruct representatives of the Owner in the proper operation and maintenance of all elements of the Electrical system.

B. Contractor shall spend not less than one (1) day in such formal instruction to fully prepare the Owner's representative to operate and maintain the Electrical systems.

3.09 UL LISTINGS

A. The Contractor shall bear all responsibility for any work, which he performs, that voids any UL listings of any equipment.

3.10 OWNER OCCUPIED BUILDINGS

A. Holes cut in Owner occupied buildings shall be done with drills with vacuum attachments that vacuum cuttings as the drill cuts.

B. All drilling, hammering, or other loud construction activities shall be done after Owner’s normal working hours.

C. Conduit cutting will be done outside.

D. Contractor shall clean work area at the end of each day.

3.11 OBJECTIONABLE NOISE AND/OR HARMONICS

A. If after installation of the electrical system, it is found that objectionable noise or harmonics exists on the electrical system, the manufacturer of the equipment which is producing the objectionable noise or harmonics shall install the proper electrical equipment to prevent the noise and/or harmonics from emitting onto the building’s electrical system and shall be contained within the offending equipment.

3.12 VOLTAGE MEASUREMENTS

A. Contractor shall measure and record voltage at service equipment with as much load on the system as possible. Contractor shall measure and record phase-to-phase, phase-to-neutral, and phase-to-equipment ground voltages for each phase. Where harmonic cancellation transformers are installed, contractor shall also measure and record phase-to-phase, phase-to-neutral and phase-to-equipment ground voltages for each phase on the secondary side of the transformers. Contractor shall submit records of these voltages with the Operation and Maintenance Manuals.

3.13 REMOVAL OF PAINT AND OTHER FINISHES

A. The contractor shall remove all paint and other non-factory finishes applied inadvertently by other subcontractors to all electrical equipment.

3.14 TEMPORARY CONSTRUCTION POWER AND LIGHTING

A. The contractor shall provide all necessary temporary construction power and lighting to accomplish the work.

B. After the construction is completed, the contractor shall remove all temporary construction power and lighting.

3.15 PROJECT PHASING

A. The contractor shall become familiar with the project phasing prior to his bidding the project and shall include in his bid, the amount of money required by him to provide the necessary labor, materials, adjustments, programming, reprogramming, and accessories to provide the project in the phases shown within the general conditions of the contract documents.

END OF SECTION 26 05 00

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 0 Specification sections, apply to work specified in this section.

1.02 REGULATORY REQUIREMENTS

A. Conform to the requirements of NFPA 70 - National Electrical Code.

1.03 DESCRIPTION OF WORK

A. The extent of general building demolition work is shown on drawings. Coordinate the required electrical work with the general demolition.

B. Demolition includes removal and disposal of demolished materials, as shown on drawings and herein specified.

C. Interior demolition includes work in crawl spaces, work above ceilings, finishes, and removal and disposal of demolished materials, as shown on drawings and herein specified.

D. The Owner shall have the option of retaining any items removed. The Contractor shall dispose of all material off site, unless directed otherwise by Owner.

1.04 JOB CONDITIONS

A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
   1. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The contractor shall visit the site and determine the actual conditions prior to bidding.

B. Partial Removal: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
   1. Storage or sale of removed items on site will not be permitted.

C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.

D. Protections: Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
   1. Install temporary electrical services, lighting, etc. as required by the Owner or authorities having jurisdiction.

E. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.

F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
   1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing fire utilities, as acceptable to governing authorities.
   2. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.

G. If Contractor is required to disconnect utility services or other services to an occupied area the Contractor shall provide temporary or alternative services to that area.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 DEMOLITION

A. Remove all branch and feeder conduit and wire back to panelboards.
   1. Where walls, ceilings, or floors are to remain, remove all devices, and wire where indicated. Provide blank cover plate at outlet box or patch wall to match existing finish as directed by the issued documents and/or the Architect/Engineer.
   2. All items shown to remain active shall be furnished with necessary accessible junction boxes and all conduit and wire as required to maintain circuit continuity.
   3. All outlet boxes which must be removed due to demolition but which must remain active in order to maintain circuit continuity shall be relocated into ceilings or walls and shall be accessible.
   4. All material, fixtures, and equipment to be reused shall be removed and stored on site. Before reinstallation all items are to be cleaned, tested, and prepared for re-use. Fixtures shall be re-lamped and new ballasts installed.
   5. Correct existing directories of load centers, panelboards, and switchboards where circuits are removed and/or added. Corrections to existing directories of load centers and panelboards shall be neatly handwritten. Nameplates are required at switchboards.
   6. Conduit in a concrete slab or that is not shown to be reused, may be abandoned provided as follows:
      a. Conduits in slab shall be cut off at top of slab.

b. Underground conduits shall be removed to 12 inches below grade before being abandoned.

7. Fire seal all holes in fire and/or smoke walls and floors where conduits are removed.

B. Remove all accessible low-voltage cables that are not to be reused.
   1. This includes data, telephone, television, audio/visual, intercom, fire alarm, security, access control, public address, and temperature control cables.
   2. Fire seal holes where these cables penetrated fire and/or smoke walls and floors.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Pay all fees related to removal and dumping.
   1. Remove and dispose of interior demolition debris only.
   2. Burning of removed materials from demolished structures will not be permitted on site.

B. Removal:
   1. Transport materials removed from demolished structures and dispose of off site.

C. Store items that Owner wishes to retain as directed by the Owner.

3.03 OUTAGES

A. The Contractor shall schedule all outages with the Owner at least two weeks in advance. Owner has the right to approve or disapprove any scheduled outages. Contractor will schedule the outage at the Owner's convenience. Contractor shall pay all costs, including overtime, necessary for the outage work schedule.

B. Refrigerators and freezers shall not be turned off for more than 1 hour. If the Contractor needs more than 1 hour, he shall install a temporary feeder to the equipment and/or rent an emergency generator to power the equipment. Contractor shall pay all costs of the generator and/or temporary feeders at no additional cost to the Owner.

END OF SECTION 26 05 01

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to plumbing, appliances, and mechanical equipment specified under other sections or Owner furnished equipment.

1.02 RELATED SECTIONS

A. Section 26 05 19 – Low-Voltage Electrical Power Connectors and Cable.

B. Section 26 05 29 – Hangers and Supports for Electrical Systems.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

D. Section 26 28 16 - Enclosed Switches and Circuit Breakers.

E. Section 28 31 00 – Fire Detection and Alarm.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. NEMA WD 1 - General Purpose Wiring Devices.

C. NEMA WD 6 - Wiring Device Configurations.

D. NFPA 72 - National Fire Alarm Code.

E. UL 498 - Attachment Plugs and Receptacles.

F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

C. Conform to requirements of the Arkansas State Fire Protection Code.

1.06 COORDINATION

A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections. Verify voltage, ampere, and phase ratings before beginning any of the work. Notify Engineer immediately of any discrepancies found. Any work installed that has to be replaced because of the contractor's failure to verify these ratings will not be reimbursed. Verify that equipment furnished under other sections has disconnects and starters, if so specified in other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

D. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS

2.01 CORDS AND CAPS

A. Manufacturers:
   1. Hubbell.
   2. Pass & Seymour.
   3. Arrow-Hart.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD-6; match receptacle configuration at outlet provided for equipment.

D. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating at branch circuit overcurrent protection.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using liquidtight flexible conduit with watertight connectors.

C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

F. Install disconnect switches, controllers, control stations, and control devices as indicated and as required by applicable codes.

G. Provide interconnecting conduit and wiring between devices and equipment where indicated.

H. All flexible conduit to pumps, chillers, air handling units, outdoor equipment, and water heaters shall be liquidtight.

I. Ground all metal equipment. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic equipment.

J. The contractor shall check overload settings, wire sizes, fuse/circuit breaker sizes & disconnect sizes of equipment provided by others for compliance with the National Electrical Code and shall:
   1. Adjust settings where possible.
   2. Advise the Engineer of non-compliance where remedy will require more than just adjustments.

END OF SECTION 26 05 02

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Building wire and cable.

B. Wiring connectors and connections.

C. Type HCF MC cable.

1.02 RELATED SECTIONS

A. Section 26 05 29 – Hangers and Supports for Electrical Systems.

B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

C. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. NETA – National Electrical Testing Association.

C. UL 83 - Thermoplastic Insulated Wires and Cables.

D. UL 486 A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

E. UL 486 C - Splicing Wire Connectors.

F. UL 1581 - Reference Standard for Electrical Wires, Cables and Flexible Cords.

G. UL1569 standard for metal clad cables section 6.1.5A

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide for each wire and cable type.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with experience.

1.06 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.07 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductors shall be copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.08 COORDINATION

A. Determine required separation between cable and other work.

B. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - BUILDING WIRE AND CABLE

A. Southwire.

B. American.

C. Engineer Approved.

2.02 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THW (feeder circuits) and THHN/THWN (branch circuits).

2.03 WIRING CONNECTORS/LUGS

A. All cable and wire terminals, lugs, taps, and splices shall be made secure with compression type connectors, approved for the service. Connections shall be installed with approved tools and dies to assure a permanent secure joint. Compression joints shall be cleaned and made smooth with insulating compound. Connectors in dry locations shall be wrapped with varnish cambric and insulated with approved electrical grade plastic tape. Where conductors are to be connected to metallic surfaces, the coated surfaces of the metal shall be polished before

installing the connector. Lacquer coating of conduits shall be removed where ground clamps are to be installed. Provide all necessary hangers, racks, cleats, and supports required to make a neat installation. Wire connectors shall conform to UL 486.

B. Connectors in wet or damp locations shall be covered with heat shrinkable products equal to Scotch #ITCSN Series.

C. Contractor shall provide and install all connectors, taps, lugs, and splices as required to connect all wires and cables provided under the contract. Contractor shall torque all bolted connections to manufacturer's specifications. If manufacturer's specifications do not apply, use NETA specifications.

D. Type HCF MC Cable
   1. Green lightweight aluminum interlocked armor.
   2. Copper type thin conductors.
   3. Green insulated copper type thin conductor.
   4. Redundant combined interlocked armor and full-size bake aluminum ground / bonding conductor.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation verify that interior of building has been protected from weather.

B. Prior to installation verify that mechanical work likely to damage wire and cable has been completed.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 WIRING METHODS

A. Interior Locations: Use only building wire, Type THW or use THHN/THWN insulation, in raceway in exposed areas and in accessible ceiling areas unless otherwise indicated on the Drawings.

B. Wet or Damp Interior Locations: Use only building wire, Type THW or THHN/THWN in raceway or liquidtight flexible conduit.

C. Exterior Locations: Use only building wire, Type THW or THHN/THWN insulation in raceway.

D. Underground Installations: Use only building wire, Type THW or USE insulation in raceway.

E. Use wiring methods indicated on Drawings.

F. On the load side of GFIC circuit breaker, use only Type XHHW conductors.

G. Interior locations in wood stud walls: use HCF MC cable in wall cavities only.

Do not use MC cable in accessible lay-in ceiling or exposed locations.

3.04 INSTALLATION

A. Install products in accordance with manufacturers instructions.

B. Use solid conductors for feeders and branch circuits No 10 AWG and smaller, except branch circuits to motors shall be stranded copper for flexibility. Stranded conductors may be used if tapped to solid conductors before terminating to wiring devices.

C. Use stranded conductors for control circuits 24 volts and below. Minimum size shall be No. 16 AWG.

D. Use conductors not smaller than No. 12 AWG for power and lighting circuits and 120-volt control circuits.

E. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet or where the distance to the first outlet exceeds 50 feet.

F. Pull all conductors into raceway at same time.

G. Use suitable wire pulling lubricant for building wire No. 4 AWG and larger.

H. Protect exposed cable from damage.

I. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

J. Use suitable cable fittings and connectors.

K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

L. Clean conductor surfaces before installing lugs and connectors.

M. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Split bolt connectors are not allowed.

N. Use sleeve compression connectors for copper conductor splices and taps, No. 6 AWG and larger. Insulated uninsulated conductors and connector with heat shrink insulation rated 600 volts.

O. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, No. 8 AWG and smaller.

P. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, No. 10 AWG and smaller.

Q. Route circuits at own discretion; however, circuit numbers shall be according to Drawings.

R. Do not share neutral on circuits.

S. On single phase, three wire systems do not use a common neutral for more than 2

circuits.

T. Run conductors of same circuit in same conduit.

U. Run conductors of different voltage system in separate conduits.

V. Color-code conductors as follows:

	208Y120 Volts	Switchlegs
Phase A	Black	Violet
Phase B	Red	Pink
Phase C	Blue	
Ground	Green	
Neutral	White	

W. Contractor shall not install more than three (3) current-carrying conductors in one conduit without derating the conductors per NEC Table 310-15(b)(2)(a).

X. Where cables not in conduit pass through floors, cables shall be enclosed in conduit extending at least 6 inches above the floor.

Y. Cables shall be protected from physical damage where necessary by conduit.

Z. All cable splices shall be made in boxes.

AA. The radius of bends in cables shall not be less than five times the diameter of the cable.

BB. Cables shall be secured by staples, straps, j-hooks, or similar fittings every 4-1/2 feet and within 12 inches of every cabinet, box and fitting.

CC. Do not pull cable sheaths back more than necessary to separate conductors.

DD. Do not score conductors when peeling back conductor insulation. Scored conductors will be replaced.

EE. Do not cut off strands from stranded conductors at terminations. Conductors with strands missing shall be replaced.

FF. Kinked, torn, or twisted cable sheaths are unacceptable and shall be replaced.

GG. Install wire and cables to avoid chemicals, cold temperature bending, and different lengths of conductors of same circuit.

HH. Make sure conduits are properly terminated, reamed and brushed before installation of wire and cables.

II. Cable sheaths shall be held in place by strain relief fittings.

JJ. Verify proper conductor location at each termination before energizing.

KK. All parallel conductors shall be of the same length, type, size and shall have the same connector pressures.

LL. Do not splice service entrance or feeder conductors.

MM. Maintain 18-inch clearance from all wires and cables to hot water pipes, steam pipes, and flues.

NN. Route all cables parallel and perpendicular to walls. This includes cables installed above ceilings, in attics, and in crawl spaces.

3.05 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of 26 0553 – Identification for Electrical Systems.

B. Identify each conductor with its circuit number or other designation indicated on Drawings in each junction box, switch, switchboard, control panel, and in each panelboard.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing.

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values, if applicable. If not applicable, use NETA’s recommended values.

D. Verify continuity of each branch circuit conductor.

E. Check tightness of all connections.

3.07 USE OF THE FOLLOWING IS PROHIBITED

A. Aluminum conductors.

B. Wire nuts in damp or wet locations.

C. Copper-clad aluminum conductors.

END OF SECTION 26 05 19

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

D. Chemicals.

E. Conduit.

1.02 RELATED SECTIONS

A. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. UL 467 - Grounding and Bonding Equipment.

1.04 GROUNDING ELECTRODE SYSTEM

A. Metal underground water pipe, if any.

B. Metal frame of the building, if any.

C. Electrode.

D. Rod electrode.

E. GEM encased in direct contact with earth.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: No greater than 5 ohms.

1.06 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide data for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of exothermic connectors.

1.07 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual locations of grounding electrodes.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.01 ROD ELECTRODE

A. Material: Copper clad steel.

B. Diameter: 3/4 inch.

C. Length: 10 feet.

2.02 WIRE

A. Material: Stranded or solid copper.

B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

C. Wire shall conform to Section 26 05 19.

2.03 EXOTHERMIC CONNECTIONS

A. Cadweld.

B. Approved Equal.

2.04 CHEMICALS

A. Ground enhancement materials (50 lbs. minimum per rod).

B. Cadweld "GEM" system, or approved equal.

2.05 CONDUIT

A. Conduit shall conform to Section 26 05 33.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that final backfill and compaction has been completed around area where chemical ground is to be installed.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Auger a 3-inch diameter hole to a depth of 9-1/2 feet.

C. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Drive rod 1 foot into ground. Make Cadweld connection. Pour chemicals around rod. Tamp around rod. Pour water in augered hole. Remove excess water from hole. Fill remainder of augered hole with soil. Tamp soil.

D. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus or bushing.

F. Size and type of green equipment ground conductors and method of securing then to obtain electrical continuity and effective grounding as per National Electrical Code, Article 250. Conduit shall not be used for grounding.

G. Neutrals shall be grounded in accordance with the National Electrical Code.

H. All metal raceway system, including cabinets, conduit and boxes, shall be grounded in accordance with the National Electrical Code.

I. An equipment ground conductor shall be installed in all conduits.

J. Install a grounding electrode and grounding electrode conductor at the service equipment, meter, current transformer cabinet, and at each dry type transformer.

K. The grounding electrode shall be connected to the metal structure of all buildings with metal structures and to a 1-1/2 inch or larger cold-water pipe, if metallic. The ground connection to the metal structure shall be exothermic.

L. All unburied grounding conductors shall be installed in conduit.

M. Provide grounding of pad-mounted transformer as required by the Utility.

N. Connect equipment ground conductor of branch circuits serving gas appliances to metallic gas lines. Do not use metallic gas lines as a grounding electrode of the electrical system.

O. Ground all metal non-current carrying equipment. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic equipment.

3.03 FIELD QUALITY CONTROL

A. Inspect equipment grounding conductors and connections for tightness and proper installation.

B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION 26 0526

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Conduit, cable and equipment supports.

B. Anchors and fasteners.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. NECA - National Electrical Contractors Association.

C. UL 514B - Fittings for Conduit and Outlet Boxes.

1.03 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide manufacturer's catalog data for fastening systems.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners, and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Perforated strap iron will not be acceptable as hanger or fastening material.

D. Plastic tie wraps will not be acceptable as support materials, except:
1. Inside enclosures to neatly train cables and wires.

E. Channels shall be galvanized and not painted.

F. All hardware shall be galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, and other conduit.

D. Obtain permission from the Engineer before using powder-actuated anchors.

E. Obtain permission from the Engineer before drilling or cutting structural members.

F. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

G. Install surface-mounted cabinets with minimum of four anchors. Provide blocks between studs to support anchors.

H. In wet and damp locations use steel channel supports to stand cabinets one inch off wall.

I. All conduits, both horizontal and vertical, shall be accurately supported. Each hanger shall be properly sized to fit supported conduit.

J. Where lines are supported under concrete construction, hanger rods shall be secured with concrete inserts.

K. All hangers shall be so located as to properly grade and support horizontal conduits without appreciable sagging of these lines.

L. Where multiple conduits are run horizontally at the same elevation and grade, they may be supported on trapezes of channels suspended on rods. Trapeze numbers, including suspension rods, shall be properly sized for number, size, and loaded weight of conduits to be supported.

M. Conduit supports shall be installed within 3 feet of each coupling, connector, and box.

N. Electrical contractor shall install his own supports for his equipment.

O. All 2 inch and larger conduits shall have a swivel hanger support equal to B-Line #B446 or #B446C.

END OF SECTION 26 05 29

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rigid steel conduit.

B. Flexible metal conduit.

C. Liquidtight flexible metal conduit.

D. Electrical metallic tubing.

E. PVC conduit.

F. Fittings and conduit bodies.

G. Wall and ceiling outlet boxes.

H. Floor boxes.

I. Pull and junction boxes.

1.02 RELATED SECTIONS

A. Section 26 05 02 - Equipment Wiring Systems.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 – Hangers and Supports for Electrical Systems.

D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

E. Section 26 05 53 - Identification for Electrical Systems.

F. Section 26 27 26 - Wiring Devices.

1.03 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

C. ANSI/NFPA 70 - National Electrical Code.

D. NECA "Standard of Installation”.

E. NEMA TC 3 - PVC Fittings to Use with Rigid PVC Conduit and Tubing.

F. UL 1 - Flexible Metal Conduit.

G. UL 5 - Surface Metal Raceways and Fittings

H. UL 6 - Rigid Metal Conduit.

I. UL 360 - Liquid-tight Flexible Steel Conduit.

J. UL 652 - Schedule 40 and 80 Rigid PVC Conduit.

K. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

M. UL 38 - Boxes for Use with Fire-Protection Signaling Systems, Manually Actuated Signaling.

N. UL 50 - Cabinets and Boxes.

O. UL 514A - Metallic Outlet Boxes.

P. UL 514B - Fittings for Conduit and Outlet Boxes.

Q. UL 996 - Electrical Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

R. UL 1241 - Junctions Boxes for Swimming Pool Lighting Fixtures.

S. UL 1773 - Termination Boxes.

T. UL 65 - Wired Cabinets.

1.04 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.05 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, non-metallic conduit, fittings, and conduit bodies.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual routing of conduits larger than 2 inches.

B. Submit under provisions of Division 1.

C. Accurately record actual locations and mounting heights of outlet, pull, and

junction boxes.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site.

B. Inspect all conduit for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.09 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit and openings prior to rough-in.

C. Route conduit as shown on Drawings in approximate locations unless specifically dimensioned. Route as required to complete wiring system.

D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. The exact location of all electrical boxes shall be as approved by Engineer who reserves the right to change any outlet for a distance of 6 feet in any direction from position shown on plans, before work is roughed-in, without extra charge.

PART 2 - PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Minimum Size: 3/4 inch unless otherwise specified.

B. Underground Installations:
   1. Conduit installed below grade shall be Schedule 40 PVC. All elbows and riser up thru floor slabs shall be galvanized rigid steel conduit (RSC).
   2. All conduit not installed under the floor slab shall be 24 inches below grade unless otherwise noted.

C. Outdoor Locations, Above Grade, and On Roofs: Use galvanized rigid steel conduit. On roofs install 4 inch by 4 inch square treated wooden blocks on roof to support rigid steel conduit within 3'-0" of each coupling and box and to support liquidtight flexible conduit every 3'-0".

D. Dry Locations:

1. Concealed: Use electric metallic tubing.
2. Exposed: Use electric metallic tubing.

E. Mechanical and Electrical Rooms:
1. Use 6'-0" maximum length liquidtight flexible conduit for final connections to mechanical equipment and dry type transformers. Support all flexible conduit every 3'-0".

F. Electrical metallic tubing (EMT) is to be used for all HVAC equipment control wiring. The conduit system for HVAC temperature controls is to be furnished and installed by Division 23 in accordance with the requirements specified herein. Line voltage control work not specifically shown on the electrical drawings shall be furnished and installed by Division 23 with all line voltage work and all conduit work performed by licensed electricians.

2.02 RIGID STEEL CONDUIT

A. Manufacturers:
1. Allied.
2. Wheatland.
3. Engineer Approved.

B. Rigid Steel Conduit: ANSI 80.1

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.03 FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Allied.
2. Wheatland.
3. Engineer Approved.

B. Description: Interlocked steel construction.

C. Fittings: ANSI/NEMA FB 1.

D. Maximum Length: 6'-0".

2.04 LIQUIDTIGHT METAL CONDUIT

A. Manufacturers:
1. Allied.
2. Wheatland.
3. Engineer Approved.

B. Description: Interlocked steel construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1.

D. Maximum Length: 6'-0".

2.05 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied.
   2. Wheatland.
   3. Engineer Approved.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; die-cast compression type.

2.06 NONMETALLIC CONDUIT

A. Manufacturers:
   1. Carlon.
   2. Cantex.
   3. Engineer Approved.

B. Description: NEMA TC 3; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.07 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported, include 1/2-inch male fixture studs where required.
   2. Receptacle, single switch, and 2 gang switch boxes for wood studs shall be Raco #194 or #235 with plaster ring of proper depth.
   3. Receptacle, single switch, and 2 gang switch boxes for metal studs shall be Raco #196 or #235 with plaster ring for proper depth.
   4. Gang switches of 3 or more devices for wood or metal studs and exposed work shall be Raco #950 Series, appropriate gang box and raised cover.
   5. Lighting fixture outlet boxes for wood or metal studs, masonry walls, and furred ceilings shall be Raco #166, #167, or Raco #194 or #235 with plaster ring.
   6. Junction boxes for wood or metal studs, masonry walls, furred ceilings and interior exposed work shall be Raco #231, #232, #233, or #235.
   7. Receptacle boxes for masonry walls shall be Raco #695 or #191 with #785 device cover.
   8. Switches in 6 inch and wider masonry walls shall be 3-1/2-inch-deep masonry boxes of gang required. Masonry boxes in 4-inch walls shall be 2-1/2 inches deep.
   9. Television outlet boxes shall be Raco #246, 4-1/16-inch box with #836 device cover ring. Telephone outlet boxes shall be Raco #256.
   10. Outlet boxes for interior exposed work in unfinished areas shall be Raco #191, #192, #231, or #232 boxes with 1/2 inch raised, 4-inch square cover of appropriate configuration.
   11. Boxes, for interior exposed work on existing walls and ceilings in finished areas in existing buildings, where it is impossible to fish conduit down walls or above ceilings, shall be boxes as manufactured by the surface metal raceway manufacturer for the intended purpose.

B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer.

C. Boxes shall be oversized when required by Table 370-16(a) of the National Electrical Code.

2.09 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface-Mounted Cast Metal Box: NEMA 250, Type as required; flat-flanged, surface-mounted junction box.
1. Material: Galvanized steel.

C. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation".

B. Arrange supports to prevent misalignment during wiring installation.

C. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Supports shall be installed within 3 feet of every outlet box, junction box, panel, or other conduit terminations. Fastening of unbroken lengths shall be permitted to be increased to a distance of 5 feet where structural members do not readily permit fastening within 3 feet. Do not space supports further than 10 feet apart.

D. Group related conduits; support using conduit rack. Construct rack using steel channel.

E. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.

F. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

G. Do not attach conduit to ceiling support wires.

H. Arrange conduit to maintain headroom and present neat appearance.

I. Route all conduit parallel and perpendicular to walls. This includes conduit installed above ceilings, in attics, on roofs, and in crawl spaces.

J. Install insulated bushings or approved equivalent on each end of all conduit.

K. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

L. Cut conduit square using saw or pipe cutter; de-burr cut ends.

M. Bring conduit to shoulder of fittings; fasten securely.

N. Install no more than equivalent of four 90-degree bends between boxes. Use factory elbows for all 90-degree bends in conduits 1" and larger.

O. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

P. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

Q. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.

R. Ground and bond conduit under provisions of Section 26 0526.

S. Identify conduit under provisions of Section 26 0553.

T. Provide suitable pull boxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.

U. Holes for passage of conduits through all one-hour and two-hour drywall partitions shall be neatly cut to the required size. If holes are cut larger than necessary, they shall be covered with two (2) additional pieces of 5/8 inch type X gypsum wallboard, each 8 inches by 16 inches with a half circular cutout of the proper size, one (1) layer on one-hour partitions, and two (2) layers on two-hour partitions.

V. Holes for passage of conduits through one-hour, two-hour, and four-hour masonry walls shall be fireproofed. Fireproofing materials shall be as follows:
1. Cellular Glass Insulation: Pittsburgh Corning Corp. Foamglas "Regular" or UL rated or UNI-JAC UL rated pipe insulation, or approved equal.
2. Fire Retardant Putty: IPC Flamesafe Type FAS500 or FST600 Series, or improved equal, for one-hour and two-hour walls.
3. IPC/KB5 Mortar Seal, or approved equal (full depth of wall) for four-hour walls.

W. Holes for passage of conduits through masonry floors shall be fireproofed. Fireproofing material shall be Firestop Compound - IPC Flamesafe Type 500/FST 600, or approved equal, filled to full depth of slab. Minimum annular space around conduit shall be 3/16 inch.

X. Refer to Architectural drawings for locations of fire-rated walls, ceilings, and floors.

Y. Support 2-1/2 inch and larger conduit in accordance with Section 26 05 48.

A. All flexible conduit in Mechanical Rooms and outside shall be liquidtight flexible conduit.

AA. Make sure conduits are properly terminated, reamed, and brushed before installation of wire or cable.

BB. Install bushings on all conduits.

CC. Structural Engineer shall approve placement of conduits in all concrete slabs,

beams, and columns. See Structural Drawings for structural engineer's name and address.

DD. Conduits which pass from an air-conditioned space to a non-air-conditioned space shall have sealoffs installed on non-air-conditioned side near wall.

EE. Ground metallic conduits.

FF. Install gasketed conduit hubs on all conduits exiting the top or sides of NEMA 3R enclosures.

GG. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.

HH. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

II. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

JJ. Install boxes to preserve fire resistance rating of partitions and other elements.

KK. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

LL. Use flush mounting outlet boxes in finished areas, unless noted otherwise on the Drawings.

MM. Do not install flush mounting boxes back-to-back in walls; provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic rated walls. See Architectural floor plans for acoustic rated wall locations.

NN. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

OO. Use stamped steel bridges to fasten flush mounting outlet box between studs.

PP. Install flush mounting box without damaging wall insulation or reducing the effectiveness.

QQ. Use adjustable steel channel fasteners for hung ceiling outlet box.

RR. Do not fasten boxes to ceiling support wires.

SS. Support boxes independently of conduit.

TT. Use gang box where more than one device is mounted together. Do not use sectional box.

UU. In other than masonry, use 4-inch square by 1-1/2-inch minimum box with plaster ring for single devices.

VV. Use cast outlet box in exterior locations exposed to the weather and wet locations.

WW. Use cast floor boxes for installations in slab on grade. Coordinate cover trim with floor covering thickness and type.

XX. Set floor boxes level.

YY. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
1. Interior Dry Locations: Use hinged enclosure.
2. Other Locations: Use surface-mounted cast metal box.

ZZ. Locate boxes so outlets are not obstructed by pipes, ducts, or other items.

AAA. Boxes for light switches shall generally be located within 6 inches of door jamb.

BBB. Pullboxes shall be provided at points shown on plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction. No runs of over 100 feet shall be made without use of pullbox.

CCC. All boxes shall have covers. All boxes installed above a ceiling and installed in unfinished spaces (Mechanical and Electrical Rooms, etc.) shall have the covers clearly and legibly marked with the circuits contained within them.

DDD. All flush-mounted boxes shall come within 1/4 inch of finished non-combustible surfaces and shall be flush with finished combustible surfaces. Install box extensions, if after rough-in and wall construction, the boxes do not come out far enough.

EEE. Ground all boxes. Ensure that bonding breaks through paint to bare metallic surface.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance of partitions and other elements.

B. Pullboxes shall be provided at points shown on the plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction.

C. All threaded conduit shall be secured to boxes, cabinets, panels, switches, etc. by means of a threaded bushing on the inside and locknutted on the box exterior and interior.

D. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

E. Coordinate mounting heights and locations of outlets mounted above counters, branches, and backsplashes with Architect prior to rough-in.

F. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.03 THE FOLLOWING ARE PROHIBITED

A. EMT crimp-on, tap-on, indenter type fittings.

B. EMT set- screw fittings. Set-screw fittings on ends of flexible conduit are allowed.

C. PVC inside buildings, or above grade.

D. All thread nipples in other than dry locations.

E. Wooden plugs inserted in concrete or masonry units as bases for fastening conduits, tubing, boxes, cabinets, or other equipment.

F. Installation of conduit or tubing which has been crushed or deformed.

G. Where conductors #8AWG or larger are inside, the following fittings shall not be used:
1. 90° threaded hubs.
2. Pulling elbows.
3. Bushed elbows.
4. Short box connectors.
5. 90° connectors.
6. Entrance elbows.
7. Types LB, LL, LR, T, L, TA, TB, X, LBD, or LBDN conduit bodies.
8. Short elbows.

H. Type ENT tubing.

I. Armored cable.

J. Metal-clad cable.

K. EMT on roof, exposed, outside, in concrete, or underground.

L. Flexible or liquidtight flexible conduits concealed in walls or floors.

M. PVC elbows.

N. Storage of PVC in sunlight.

O. The use of heat to bend PVC conduit.

P. Surface non-metal raceway.

Q. Surface metal raceway in new buildings.

R. Surface metal raceway in damp or wet locations.

S. Flexible or liquidtight flexible conduits in lengths exceeding 6'-0".

T. The use of external coverclips on surface metal raceway.

U. All steel EMT fittings.

V. Flexible conduit connectors on which the flexible conduit is threaded.

W. Plastic boxes.

X. Fiberglass boxes.

END OF SECTION 26 05 33

PART 1 - GENERAL

1.01 SCOPE

A. The requirements for seismic protection measures to be applied to electrical equipment specified herein are in addition to any other items called for in other sections of these specifications. The seismic protection shall conform to Category D of the 2005 Arkansas Fire Prevention Code. The electrical equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

Conduit, 2-1/2 inches or larger
Panelboards
Cable Trays
Switches
Light Fixtures
Switchboards
Communication Racks

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Electrical Requirements - Section 26 05 00.

1.03 APPLICABLE PUBLICATIONS

A. American National Standards Institute, Inc. (ANSI):
1. B18.2.1-1981
2. B18.2.2-1972

B. American Society for Testing and Materials (ASTM):
1. A36-84a
2. A307-84
3. A325-85
4. A501-84
5. A576-81

C. Federal Specifications:
1. RR-W-410D

D. NEMA
1. 250 Enclosures for Electrical Equipment
2. IC56

1.04 REGULATORY REQUIREMENTS

A. Conform to NFPA 70 - National Electrical Code and International Building Code.

B. Conform to 2021 Fire Prevention Code.

PART 2 - PRODUCTS

2.01 Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

2.02 Sway brace of structural steel conforming with ASTM A36.

2.03 Mechanical couplings of the sleeve type to provide a tight flexible joint under all reasonable conditions.

2.04 Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B12.2.2 and ASTM A307 or 306.

2.05 Guy wires where required shall conform to Fed Spec. RR-W-441 as follows:

5/32" diameter	Type V, Class 1
3/16" to 5/16" diameter	Type V, Class 2
1/4" to 5/8" diameter	Type I, Class 2

PART 3 - EXECUTION

3.01 All rigidly mounted equipment will have a minimum of four (4) anchor bolts securely fastened through bases or backs. Anchor bolts must conform to ASTM A307. Anchor bolts shall have an embedded straight length equal to at least twelve times the nominal diameter of the bolt and shall conform to the applicable tables for various equipment weights.

Maximum Equipment Weight (Pounds)	
500	1/2
1,000	1/2
5,000	1/2
10,000	1/2
20,000	1/2
30,000	5/8
50,000	3/4
100,000	1

Based on four (4) bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Use equivalent total cross-sectional area when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths. When height-to-width ratio of the equipment exceeds 8.9, overturning must be investigated. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure, except that an equipment weight equal to five times the actual equipment weight shall be used. Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.02 Equipment Sway Bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree

angle from the equipment frame to the building structure secured at both ends with no less than 1/2 inch bolts. Braces shall conform to all applicable codes and standards for Seismic Classification. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45-degrees, provided that supporting members are properly sized to supporting operating weight of equipment when inclined at a 45-degree angle.

3.03 All recessed fluorescent light fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster frames.

3.04 Sway bracing shall be provided for all 2-1/2 inch or larger conduits, not individually supported with hangers 12 inches or less in length.

3.05 All 2-1/2 inch or larger conduits entering or leaving a building or structure shall have a flexible seismic expansion fitting installed within the earth prior to entering the building or after leaving the building. Fitting shall be within 5'-0" of building or structure. Fitting shall be equal to Appleton Type DF.

3.06 All light fixtures that weight more than 50 pounds shall have a safety chain or safety cable in addition to its other support.

3.07 Sway bracing shall be provided for all cable trays.

3.08 Communications racks shall be bolted to floor. Tops of racks shall be bolted to walls.

3.09 Cable trays and conduits shall be independently supported and braced independently of the ceiling.

3.10 Powder-activated fasteners (shot pins) shall not be used for anchorage.

3.11 Vibration isolators shall have a bumper restraint in each horizontal direction, and vertical restraints shall be provided where required to resist overturning.

3.12 Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure.

3.13 Slide-out components in electrical equipment shall have a latching mechanism to hold contents in place.

3.14 Electrical cabinet design shall conform to NEMA 250 and NEMA IC56.

3.15 The attachment of additional items weighing more than 100 pounds to electrical equipment is prohibited.

3.16 Friction clips shall not be used for anchorage attachments.

3.17 Oversized plate washers extending to the equipment wall shall be used at bolted connections through the base sheet metal if the base is not reinforced with stiffeners or not capable of transferring the required loads.

END OF SECTION 26 05 48

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Trench tape.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

B. Locations:
   1. Each electrical distribution equipment (switchboards, panelboards, enclosed circuit breakers, motor control centers, transformers) and control equipment enclosure (starters, disconnect switches, etc.).

C. Letter Size:
   1. Use 1/2 inch letters for identifying equipment designation and voltage.

D. Provide typewritten directory in each panelboard of circuit designations in clear/transparent protective envelope attached to inside of panelboard door.

E. Provide typewritten zone directory in each conventional fire alarm control panel

in clear/transparent, protective envelope attached to inside of central panel door.

F. Provide nameplate on inside of each panelboard and main indicating color code scheme for the voltage of that panelboard and main, nameplates to be red with white characters.

2.02 WIRE MARKERS

A. Description: Tape or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters switchboard gutters, motor control center gutters, pull boxes, outlet and junction boxes, disconnect switches, motor starters, and at each load connection.

C. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2.03 TRENCH TAPE

A. Tape shall be detectable aluminum foil polyethylene laminate.

B. Tape shall be the following color and have the following wording:

Application	Color	Caution Wording
Cable TV	Orange	"Caution – Cable TV Line Buried Below"
Electrical	Red	"Caution – Electric Line Buried Below"
Telephone	Orange	"Caution – Telephone Line Buried Below:
Fiber Optic	Orange	"Caution – Buried Fiber Optic Cable"

C. Tape shall be equal to Panduit Type HTDU with width to match trench width.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 APPLICATION

A. Install nameplate and label parallel to equipment lines.

B. Secure nameplate to equipment front using No. 4 round heat cadmium plated, steel self-tapping screws or nickel-plated brass plates.

C. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade.

D. All fire alarm junction boxes and pullboxes shall be painted red where concealed or exposed in mechanical or electrical rooms.

E. Both ends of pullwires shall be identified by means of labels or tags, reading "PULLWIRE" and shall be numbered to refer to same pullwire.

F. Install nameplates at each circuit breaker on all switchboards and large panelboards.

G. Install wire markers on wires in each junction box, panelboard, switchboard, control panel, etc.

H. Install nameplates at each device within motor control centers.

I. Install directory of addresses and corresponding devices and locations in each addressable fire alarm and security control panels.

J. All security junction boxes and pullboxes shall be painted yellow where concealed or exposed in mechanical or electrical rooms.

K. Install labels on all telephone and computer cables.

L. All telephone junction boxes and pullboxes shall be painted white where concealed or exposed in mechanical or electrical rooms.

M. Paint all data junction boxes and pullboxes blue where concealed or exposed in mechanical or electrical rooms.

N. Paint all public address junction boxes and pullboxes dark gray where concealed or exposed in mechanical or electrical rooms.

O. Paint all television cable junction boxes or pullboxes black where concealed or exposed in mechanical or electrical rooms.

END OF SECTION 26 05 53

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by Square D Engineering Services, Cutler Hammer Engineering Services or Siemens Engineering Services.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)
1. NFPA 70 -National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 SUBMITTALS

A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.04 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Electronic PDF copies of the report shall be provided upon request.

B. The report shall include the following sections:
   1. Executive Summary including Introduction, Scope of Work and Results / Recommendations.
   2. Short-Circuit Methodology Analysis Results and Recommendations
   3. Short-Circuit Device Evaluation Table
   4. Protective Device Coordination Methodology Analysis Results and Recommendations
   5. Protective Device Settings Table
   6. Time-Current Coordination Graphs and Recommendations
   7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
   8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
   9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.05 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.

C. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

1.07 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program.

PART 2 - PRODUCTS

2.01 STUDIES

A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by Square D Engineering Services.

2.02 DATA

A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:
   1. Calculation methods and assumptions
   2. Selected base per unit quantities
   3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
   4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
   5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
   6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short circuit ratings
   2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
   3. Square D shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.04 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title with descriptive device names.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
6. Medium voltage conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points, where applicable
9. Pertinent generator short-circuit decrement curve and generator damage point
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Provide the following:
1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

2.05 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)

B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. Circuits 240V or less where available bolted short circuit current is less than 10 kA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E Table 130.7(C)(9)(a), including footnote 3.

D. Circuits 240V or less fed by transformers 112.5 kVA or less may be omitted from the computer model and will be assumed to have a hazard risk category 0 per IEEE 1584.

E. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

F. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

G. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond 5 cycles.

I. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection

boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

M. Provide the following:
1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 - EXECUTION

3.01 FIELD ADJUSTMENT

A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

Field adjustments to be completed by switchgear manufacturer services under the separate Startup and Acceptance Testing contract portion of project specifications.

B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

3.02 ARC FLASH LABELS Square D Engineering Services shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.

A. The labels shall be designed according to the following standards:
1. UL969 – Standard for Marking and Labeling Systems
2. ANSI Z535.4 – Product Safety Signs and Labels
3. NFPA 70 (National Electric Code) – Article 110.16

B. The label shall include the following information:
1. System Voltage
2. Flash protection boundary
3. Personal Protective Equipment category
4. Arc Flash Incident energy value (cal/cm^2)
5. Limited, restricted, and prohibited. Approach Boundaries
6. Study report number and issue date

C. Labels shall be printed by a thermal transfer type printer, with no field markings.

D. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

Label Installation

E. Labels shall be field installed by Square D Services. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course with includes NFPA 70E material including the selection of personal protective equipment.

3.03 ARC FLASH TRAINING

A. The vendor supplying the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent. The trainer shall be an authorized OSHA Outreach instructor.

B. The vendor supplying the Arc Flash Hazard Analysis shall offer instructor led and online NFPA 70E training classes.

END OF SECTION 26 05 73

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Branch circuit panelboards.

1.02 RELATED SECTIONS

A. Section 26 05 29 – Hangers and Supports for Electrical Systems.

B. Section 26 05 53 - Identification for Electrical Systems: Engraved nameplates.

C. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

A. NECA (National Electrical Contractors Association) "Standard of Installation."

B. NEMA AB 1 - Molded Case Circuit Breakers.

C. NEMA PB 1 - Panelboards.

D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less.

E. NFPA 70 - National Electrical Code.

F. UL 67 - Panelboards.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 RECORD DOCUMENTS

A. Record actual locations of Products; indicate actual branch circuit arrangement.

1.06 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and

intervals.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.11 MAINTENANCE MATERIALS

A. Provide two of each panelboard key.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Square D.

B. General Electric.

C. Siemens/ITE.

D. Cutler-Hammer.

2.02 PANELBOARDS

A. Panelboards: NEMA PB1, circuit breaker type.

B. Panelboard Bus: Tin-plated copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

C. Minimum short circuit rating, shall be as indicated on the Drawings. Panelboards shall have a fully rated interrupting rating. Series-rated equipment will not be accepted.

D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Provide circuit breakers UL listed as Type HACR for air conditioning equipment

branch circuits.

E. Enclosure: NEMA PB 1, Type 1, or 3R as indicated on the Drawings.

F. Cabinet box: 6 inches deep; width: 20 inches for 240 volt and less panelboards.

G. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.03 MODIFICATIONS TO EXISTING PANELBOARDS

A. Provide and install all bus extensions, bus stabs, enclosures, etc. to install circuit breakers in existing panelboards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb. Provide supports in accordance with Section 16190.

C. Install panelboards with middle at 48 inches, if less than 6'-6" tall. If panelboard is taller than 6'-6 inches, install with top at 7'-6".

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

G. Provide a minimum of four (4) spare 20A/1P circuit breakers in each branch circuit panelboard or as indicated on the drawings.

H. Install all screws and bolts in coverplates.

I. Install knockout plugs in all unused openings in enclosure.

J. Install nameplates on all circuit breakers of large panelboards.

K. Bolt panelboards to mounting surface in accordance with Section 26 05 48.

L. Panelboards installed on basement walls or outside on exterior walls shall be installed on 1-1/2 inch channel.

M. The first section of multi-section panelboards shall have feed-through lugs. Contractor shall install conductors with ampacities equal to the bus rating of the panelboards, from the feed-through lugs to the main lugs only of Section #2 panelboard.

N. Touchup scratched or marred surfaces to match original finish.

O. Neatly form wire inside of panelboard.

3.02 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections using calibrated torque wrench for circuit breakers, bus stabs, and busses.

END OF SECTION 26 24 16

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Arrangement with Utility Company for permanent and temporary electric services, including payment of Utility Company charges for service.

B. Underground service entrance.

C. Metering equipment.

1.02 RELATED SECTIONS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 – Hangers and Supports for Electrical Systems.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. NETA – National Electrical Testing Association.

1.04 SYSTEM DESCRIPTION

A. Utility Company: Entergy of Arkansas.

B. System Characteristics: 208 volts, three phase, four- wire, 60 Hertz.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with Utility Company written requirements.

B. Maintain one copy of each document on site.

1.06 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of NFPA 70 - National Electrical Code, ANSI/IEEE C2 - National Electrical Safety Code, and Arkansas Public Service Commission rules and regulations.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Utility Company drawings.

PART 2 - PRODUCTS

2.01 UTILITY CURRENT TRANSFORMER CABINET

A. Current transformer cabinet shall be purchased by Contractor from Utility Company and shall be installed by Contractor per directions from Utility Company.

2.02 TRANSFORMER PAD

A. Description: Concrete transformer pad with cable pit sized as indicated on Drawings.

2.03 GROUND GRID

A. Stranded copper conductors, exothermic connections, and copper clad steel ground rods as directed by Utility Company.

2.04 LUGS

A. Contractor shall provide lugs to the Utility to connect underground service conductors to pad-mounted transformer secondary terminals.

2.05 CONDUITS

A. Above ground conduit shall be threaded rigid steel.

B. Underground conduit shall be Schedule 40 with IMC elbows.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that service equipment is ready to be connected and energized.

3.02 PREPARATION

A. Make arrangements with Utility Company to obtain permanent and temporary electric services to the Project.

B. Coordinate location of Utility Company's facilities to ensure proper access is available.

C. Pay all fees for electrical service to Utility Company.

3.03 INSTALLATION

A. Install service entrance conduits and conductors from Utility Company's transformer to building service entrance equipment.

B. Provide cast-in-place concrete pad and ground grid for Utility Company transformer and/or free-standing C.T. cabinet.

C. Provide buried PVC conduit from primary compartment of transformer pad to Utility Company's pole as directed by Utility Company.

D. Level concrete pads.

E. Dress up areas of excavation.

3.04 FIELD QUALITY CONTROL

A. Torque lugs to NETA specifications.

END OF SECTION 26 26 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Occupancy Sensors.

D. Device plates.

1.02 RELATED SECTIONS

A. Section 26 05 33 - Boxes.

B. Section 26 05 53 - Electrical Identification: Labels on computer outlets.

1.03 REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices.

B. NEMA WD 6 - Wiring Device Configurations.

C. UL 20 - General Use Snap Switches.

D. UL 498 - Attachment Plugs and Receptacles.

E. UL 894 - Switches for Use in Hazardous (Classified) Locations.

F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Manufacturer's Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
   2. Include instructions for storage, handling, protection, examination, preparation, operation, and installation of product.

1.05 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 EXTRA MATERIALS

A. Provide protective rings and split nozzles as required and as specified.

PART 2 - PRODUCTS (NO SUBSTITUTIONS)

2.01 WALL SWITCHES

A. Single Pole Switch:
1. Hubbell #1221.
2. Pass & Seymour #20AC1.
3. Cooper Wiring Devices #2221.
4. Leviton #1221.

B. Double Pole Switch:
1. Hubbell #1222.
2. Pass & Seymour #20AC2.
3. Cooper Wiring Devices #2222.
4. Leviton #1222.

C. Three-way Switch:
1. Hubbell #1223.
2. Pass & Seymour #20AC3.
3. Cooper Wiring Devices #2223.
4. Leviton #1223.

D. Four-way Switch:
1. Hubbell #1224.
2. Pass & Seymour #20AC4.
3. Cooper Wiring Devices #2224.
4. Leviton #1224.

2.02 RECEPTACLES

A. Single Convenience Receptacle:
1. Hubbell #5361.
2. Pass & Seymour #5361.
3. Cooper Wiring Devices #5361.
4. Leviton #5361.

B. Duplex Convenience Receptacle:
1. Hubbell #5362.
2. Pass & Seymour #5362.
3. Cooper Wiring Devices #5362.
4. Leviton #5362.

C. GFCI Receptacle:
1. Hubbell #GF5352.
2. Pass & Seymour #2091.
3. Cooper Wiring Devices #XGF20.

4. Leviton #GF5352.

D. Special Purpose Receptacle:
1. Type, NEMA configuration and voltage as specified on Drawings as manufactured by:
   a. Hubbell.
   b. Pass & Seymour.
   c. Cooper Wiring Devices.
   d. Leviton.

F. Color of devices as selected by Architect/Engineer.

2.03 OCCUPANCY SENSORS

A. APPROVED MANUFACTURES
1. Hubbell
2. WattStopper
3. Engineer approved

B. TYPE: Sensors shall be “Dual Technology” unless otherwise noted on plans

C. INSTALLATION
1. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the “On” / “Off” function of the lights.
2. Time Delay settings shall be set at 10 minutes. This delay selection is based on lamp life vs. energy savings and sensor performance. Corridors and Bathroom time delay shall be set for 30 minutes to provide safety in such areas.
3. Contractor shall adjust sensor sensitivity so the device will operate properly.
4. Manufacture specified on drawings is specific to design. If an alternate manufacture is selected, the contractor is responsible for additional sensors, power pack, and additional equipment to meet the design needs. Also, contractor is to provide manufactures drawings with sensor coverage located on drawings. The revised drawing shall be included with the shop drawings. Alternate plan will only be approved once the engineer has reviewed this information.

2.04 WALL PLATES

A. Cover Plates: Stainless steel.

B. Weatherproof Enclosures:
1. Receptacles in wet locations shall be installed with an outlet enclosure clearly marked "Suitable for Wet Locations While in Use”. There shall be a gasket between the enclosure and the mounting surface, and between the cover and the base to assure proper seal.
2. The enclosure must employ stainless steel mounting hardware and be constructed of impact resistant polycarbonate. The outlet enclosure shall be UL listed and shall be as manufactured by TayMac Corporation, or approved equal.

C. Wall-mounted Occupancy Sensors: Coverplates shall be suitable for sensor type

and shape.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify conditions.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and will be completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

E. Verify color of all devices and coverplates.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install single and double pole switches with OFF position down.

D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

E. Install plates on switch, receptacle, and blank outlets in all areas.

F. Connect wiring devices by wrapping conductor around screw terminal in clockwise direction and tightening screw. Where wiring device has two (2) plates tightened by a screw, this method may be used. However, other back-connected wiring devices, which depend upon a metal spring action, are not allowed.

G. Use jumbo size plates for outlets installed in masonry walls.

H. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings, and on surface mounted outlets.

I. All plates shall be secured by means of screws with heads matching plates.

J. Vertically mounted receptacles shall be installed with equipment grounds down, unless local codes require otherwise. Horizontally mounted receptacles shall be installed with equipment grounds to the right, unless local codes require otherwise. Regardless, all receptacles, including GFCI receptacles, shall be installed in the same way with the ground, turned in the same direction.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights specified and indicated on Drawings.

B. Install wall switches 48 inches above finished floor to the center of the box.

C. Install convenience receptacle 18 (vertically oriented) inches above finished floor unless noted otherwise on Drawings.

D. Install convenience receptacle 6 (horizontally oriented) inches above finished counter.

3.05 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

F. Check tightness of all conductor connections.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

END OF SECTION 26 27 26

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fusible switches.

B. Non-fusible switches.

C. Fuses.

D. Enclosed circuit breakers.

1.02 REFERENCES

A. ASME A17.1 - Safety Code for Elevators and Escalators.

B. NECA (National Electrical Contractors Association) “Standard of Installation”.

C. NEMA AB 1 - Molded-Case Circuit Breakers.

D. NEMA KS 1 - Enclosed Switches.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment.

G. UL 98 - Enclosed and Dead-Front Switches.

H. UL 198C - High Interrupting Capacity Fuses; Current Limiting Type.

I. UL 198E - Class R fuses.

J. UL 363 - Knife Switches.

K. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures.

L. UL 1066 - Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.

M. UL 1332 - Organic Coatings for Steel for Outdoor-Use Electrical Equipment Enclosure.

1.03 RELATED SECTIONS

A. Section 09 91 00 - Painting: Touchup.

B. Section 26 05 29 – Hangers and Supports for Electrical Systems.

C. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide switch ratings and enclosure dimensions.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

1.06 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Disconnect switches shall be heavy duty, as manufactured by,
   1. Square D
   2. General Electric
   3. Siemens ITE
   4. Cutler-Hammer

2.02 ENCLOSED SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

B. Non-fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R, lockable.

B. Minimum integrated short circuit rating as indicated on the Drawings shall be fully rated rating. Series-Rated equipment will not be accepted.

C. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

D. Cabinet: Finish in manufacturer's standard gray enamel.

E. 480Y277 volt main circuit breakers rated 1000 amperes or more shall have ground fault protection.

2.04 FUSES

A. Manufacturers:
1. Bussman.
2. Gould-Shawmut.
3. Little.

B. Description: Dual element, current limiting, time delay, one-time fuse, 600 volt, UL 198E, Class RK 1.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the electrical device where indicated.

B. Install fuses in fusible disconnect switches.

C. Install equipment ground bus in enclosed circuit breaker / switch.

D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

E. Provide label on outside cover as directed by Section 26 05 53 - Identification for Electrical Systems.

F. Provide three (3) spare fuses of each type utilized.

G. Bolt enclosed circuit breaker / switch to mounting surface in accordance with Section 26 05 29.

H. Where wall-mounted circuit breaker / switches are mounted to be operated from floor or grade, install switch with middle of switch at 48 inches, if switch is less than 6'-6" tall. If switch is taller than 6'-6" tall, install switch with top of switch at 7'-6".

I. Install nameplate on disconnect switch with designation of equipment being

served by switch. If main switch, install “Main Disconnect” nameplate.

J. Touchup scratched or marred surfaces to match original finish.

K. Neatly form wires inside switches.

3.02 FIELD QUALITY CONTROL

A. Check tightness of conductor lugs using calibrated torque wrench.

END OF SECTION 26 28 16

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:
   1. Natural gas engine.
   2. Unit-mounted cooling system.
   3. Unit-mounted control and monitoring.
   4. Performance requirements for sensitive loads.
   5. Load banks.
   6. Outdoor enclosure.

B. Related Sections include the following: List below only products and equipment that the reader might expect to find in this Section but are specified elsewhere.
   1. Section 26 36 23 "Enclosed Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   4. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. 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.

B. Qualification Data: For installer, manufacturer and testing agency.

C. Source quality-control test reports.
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   5. Report of sound generation.
   6. Report of exhaust emissions showing compliance with applicable regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 26 05 00 "Operation and Maintenance Manuals," include the following:
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.09 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: 5 to 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.10 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work limited to, the following:
1. Caterpillar; Engine Div.
2. Kohler Co.; Generator Division.
3. Onan/Cummins Power Generation; Industrial Business Group.

2.02 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:
1. Power Output Ratings: Electrical output power rating for Standby operation of not less than (see plans) kW, at 80 percent lagging power factor, 120/208, Parallel Wye, 3-phase, 4 -wire, 60 hertz.
2. Alternator shall be capable of accepting maximum {see plans} kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

D. Generator-Set Performance:
1. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.03 ENGINE

A. Fuel: Natural Gas

B. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
2. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

C. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 2 equipment for heater capacity.

E. Governor: Adjustable isochronous, with speed sensing.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
   a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.

b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

H. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 12 or 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
   d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
   e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
   f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:
   1. AC voltmeter (3-phase, line to line and line to neutral values).
   2. AC ammeter (3-phases).
   3. AC frequency meter.
   4. AC kVA output (total and for each phase). Display shall indicate power flow direction.
   5. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
   6. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
   7. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
   8. DC voltmeter (alternator battery charging).
   9. Engine-coolant temperature gage.
   10. Engine lubricating-oil pressure gage.
   11. Running-time meter.
   12. Retain subparagraph below for units with "generator-protector" feature. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
   13. AC Protective Equipment: The control system shall include over/under voltage, over current, short circuit, loss of voltage reference, and over excitation shut down protection. There shall be an overload warning, and overcurrent warning alarm.
   14. Status LED indicating lamps to indicate remote start signal present at the control, existing alarm condition, not in auto, and generator set running.

15. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
16. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
17. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.

G. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature pre-alarm.
6. Lube-oil, low-pressure pre-alarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

H. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

2.05 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.06 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.

G. Enclosure: Drip-proof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: SCR type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Sub-transient Reactance: 15 percent maximum, based on the rating of the engine generator set.

2.07 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated Steel housing level 2. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

B. Construction:
   1. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
   2. Exhaust System: Muffler located within enclosure.
   3. Hardware: All hardware and hinges shall be stainless steel.
   4. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
   5. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.

C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
   2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 75 dBA measured at any location 23 ft from the engine generator in a free field environment.

E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.08 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   1. Material: Standard neoprene.

2.09 FINISHES

A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer’s standard color or as directed on the drawings.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Full load run.
   3. Maximum power.
   4. Voltage regulation.
   5. Transient and steady-state governing.
   6. Single-step load pickup.
   7. Safety shutdown.
   8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
   9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Connect engine exhaust pipe to engine with flexible connector.

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 IDENTIFICATION

A. Identify system components according to Section 23 05 53 "Identification for HVAC Piping and Equipment" and Section 26 05 53 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
7. 4-hour load bank test. Provide test results to engineer.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Remove and replace malfunctioning units and reinspect as specified above.

K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

M. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 26 32 13

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Automatic transfer switch.

1.02 RELATED SECTIONS

A. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

B. Section 26 05 53 – Identification for Electrical Systems.

C. Section 26 32 00 – Packaged Gas Engine Generator Systems.

1.03 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

D. NFPA 70 - National Electrical Code.

E. UL 1008 - Automatic Transfer Switch.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions when engine generator is running.

C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with experience.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 and Section 26 05 00.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Division 1.

B. Provide two of each special tool required for maintenance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Automatic Switch Company, service entrance rated.

B. Kohler.

C. Cummins

2.02 AUTOMATIC TRANSFER SWITCH

A. Description: NEMA ICS 2, automatic transfer switch.

B. Configuration: Electrically operated, mechanically held transfer switch.

2.03 SERVICE CONDITIONS

A. Service Conditions: NEMA ICS 1.

2.04 RATINGS

A. Voltage: 208/120 volts, three phase, four-wire, 60 Hz.

B. Switched Poles: 3.

C. Load Inrush Rating: Combination load.

D. Continuous Rating: See Drawings.

E. Interrupting Capacity: 600 percent of continuous rating.

F. Withstand Current Rating: 50,000 rms symmetrical amperes, when used with Class L current limiting fuse.

G. Service Entrance Rated with 3R enclosure.

2.05 PRODUCT OPTIONS AND FEATURES

A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.

B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Transfer Switch Auxiliary Contacts: 2 normally open; 2 normally closed.

E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent from rated nominal value.

F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent from rated nominal value.

G. In-Phase Monitor: Inhibit transfer until source and load are within 5 electrical degrees.

H. Switched Neutral: Overlapping contacts. Required for four pole only.

2.06 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

B. Time Delay To Start Alternate Source Engine Generator: 0 to 60 seconds, adjustable.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay Before Transfer to Alternate Power Source: 0 to 60 seconds, adjustable.

E. Initiate Time Delay, Retransfer Load to Normal Source: Upon permission by normal source monitor.

F. Time Delay Before Transfer to Normal Power: 0 to 180 seconds, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay Before Engine Shut Down: 0 to 300 minutes, adjustable, of unloaded operation.

H. Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

I. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

2.07 ENCLOSURE

A. Enclosure: ICS 6, Type 1, or 3R (if outside).

B. Finish: Manufacturer's standard enamel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify conditions.

B. Verify that surface is suitable for transfer switch installation.

3.02 INSTALLATION

A. Install transfer switches in accordance with manufacturer's instructions.

B. Provide engraved plastic nameplates under the provisions of Section 26 05 53

C. Install all screws and bolts in coverplates.

D. Bolt surface-mounted enclosures to mounting surface in accordance with Section 26 05 48.

E. Install 4 inch housekeeping pad for freestanding enclosures.

F. Bolt freestanding enclosures to floor in accordance with Section 26 05 48.

G. Level switch.

H. Ground switch with equipment grounding conductors in both emergency and normal power feeders.

I. Adjust doors so that they open easily and do not drag on doorframe.

J. Install engine start wires to emergency generator.

K. Install wall-mounted switches with middle of switch at 48 inches if switch is less than 6'-6" tall. Install switches taller than 6'-6" with top of switch at 7'-6".

L. Where switches are mounted on exterior basement walls or outdoors, install switch on 1-1/2 inch channels.

M. Neatly form wires in transfer switch enclosure.

N. Touchup scratched or marred surfaces to match original finish.

3.03 FIELD QUALITY CONTROL

A. Check tightness of all conductor connections with calibrated torque wrench.

3.04 DEMONSTRATION

A. Provide systems demonstration.

B. Demonstrate operation of transfer switch in normal and emergency modes.

END OF SECTION 26 36 23

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires and accessories

B. LED luminaires

C. Exit signs.

D. Inverters

1.02 RELATED SECTIONS

A. Section 26 05 29 – Hangers and Supports for Electrical Systems.

B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

C. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ANSI/NFPA 101 - Life Safety Code.

C. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

D. UL 844 - Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.

E. UL 924 - Emergency Lighting and Power Equipment.

F. NEMA SSL 1-2010 – Electronic Drivers for LED Devices, Arrays, or Systems

1.04 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each luminaire.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Maintenance Data: Include replacement parts list.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Conform to requirements of NFPA 101.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 – PRODUCTS

2.01 LUMINAIRES

A. Furnish products as specified on Drawings.

B. All factory installed wiring shall be copper.

2.02 LED LUMINAIRES

A. Furnish products as specified on Drawings.

B. Color Temperature of 3500K for interior luminaires as listed in the fixture schedule on the plans, unless otherwise noted. The color temperature of exterior LED luminaires shall not exceed 4000K (nominal), unless otherwise noted.

C. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.

D. Luminaire shall maintain 70% lumen output for a minimum of 50,000 hours.

E. Driver shall have a rated life of 50,000 hours, minimum.

F. Lumen output shall not depreciate more than 20% after 10,000 hours of use.

G. LED driver shall be compatible with dimming controls where dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.

H. LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the fixture schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire.

I.

J. The LED luminaire shall carry a limited 5-year warranty minimum (not pro-rated) for LED light engine(s)/board array, driver(s), and LED components.

2.03 EXIT SIGNS

A. Manufacturers: As indicated on Drawings.

B. Description: Self-contained exit sign fixture.

C. Housing: High impact thermoplastic unless indicated otherwise on Drawings.

D. Face: As indicated on Drawings.

E. Directional Arrows: As indicated on Drawings.

F. Mounting: As indicated on Drawings.

G. Battery: Nickel-cadmium with sufficient capacity to operate lights for 90 minutes.

H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.

I. Lamps: Manufacturers standard LED lamps.

K. Input Voltage: 120/277 volts.

2.04 INVERTERS

A. Inverter Manufacturers:
1. Bodine
2. Dual-Lite
3. Evenlite

B. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate and supporting grids for luminaires.

B. Examine each luminaire to determine suitability for lamps specified.

3.02 INSTALLATION

A. Install in accordance with manufacturers instructions.

B. In seismic design category D, E, & F, fixtures installed in lay-in ceiling grid shall be supported as follows in addition of being securely fastened to the ceiling grid. Refer to specification section 16880 for additional fixture support information.
1. Less than 10lbs: one 12-gauge safety wire connected to structure.
2. More than 10lbs but less than 56lbs: two 12-gage safety wires connected

to structure.

3. More than 56lbs: shall be supported directly from structure independent of the ceiling grid

C. Locate recessed ceiling luminaires as indicated on Architectural reflected ceiling plan.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

E. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips. On non-fire rated lay-in ceilings, Contractor shall install surface-mounted fluorescent light fixtures on 1-1/2 inch spacers.

F. Install recessed luminaires to permit removal from below. Final connections to lay-in light fixtures shall be made with 6'-0" flexible conduit from junction box to light fixture. Flexible conduit shall not go from light fixture to another light fixture.

G. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating at ceiling.

H. Install clips to secure recessed grid-supported luminaires in place.

I. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings as scheduled.

J. Install all accessories furnished with each luminaire or as required for a complete installation as indicated.

K. Connect luminaires, emergency lighting units and exit signs to outlets provided under Section 26 05 33 as indicated.

L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. All fixtures shall be guaranteed for a period of one year after final acceptance and any defects in material or workmanship during this period shall be replaced or repaired to the Engineer's satisfaction without extra cost.

O. All supports, safety chains, swivels, etc. shall be furnished as required for a complete installation.

P. Securely fasten all exit signs and emergency lighting units to surface to which they are mounted.

Q. Replace all broken or cracked lens.

R. Replace all scratched or bent reflectors and doorframes.

S. Light fixtures shall be supported by lay-in ceilings or by supports to the building structure.

T. Light fixtures shall not be supported from conduits, duct or piping.

U. All recessed light fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster rings.

V. All light fixtures that weigh more than 50 pounds shall have a safety chain or safety cable in addition to its other support.

W. 2 by 2 light fixtures shall have louvers and lamps oriented in the same direction.

X. Touchup scratched or marred surfaces to match original finish.

Y. Surface-mounted light fixtures shall be mounted at least 80 inches above the floor to the bottom of the light fixtures.

3.03 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

B. Turn off circuit breakers serving emergency self-contained ballasts, emergency lighting units, and self-contained exit signs to verify that emergency lighting is working properly.

3.04 ADJUSTING

A. Aim and adjust luminaires as indicated on Drawings or as directed.

B. Adjust exit sign directional arrows as indicated.

C. Replace luminaires that have failed lamps at Substantial Completion. LED Diodes / Drivers that fail within the first 90 days of operation will be considered defective and shall be replaced at no extra cost.

D. If Owner complains of glare from light fixtures; add glare control, adjust light fixtures, or relocate light fixture as required to remove objectionable glare.

3.05 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION 26 50 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Complete computer network system, including but not limited to:

1. Conduit as specified in Section 26 05 33.
2. Boxes as specified in Section 26 05 33.
3. Cables.
4. Outlets.
5. Connections.
6. Patch panels.
7. Testing.
8. 19 inch racks.
9. Supporting devices as specified in Section 26 05 29.

1.02 RELATED SECTIONS

A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 29 – Hangers and Supports for Electrical Systems: Supports for conduits and backboards.

D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Provide post-manufacture test reports of all wiring and cables.

C. Submit factory training certificates of all installers.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 - National Electrical Code.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

C. The Arkansas Department of Labor requires that the worker, who installs the raceways for the equipment under this Section, be paid the electrician's minimum wage rate.

1.05 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1 and Section 26 05 00.

B. Final payment will not be made unless, and until, the Contractor has provided "as built" drawings of all work performed.

1.06 QUALITY ASSURANCE

A. Install work in accordance with ANSI/EIA/TIA 568A Category 6 Addendum (Draft 5 or latest).

B. Contractor shall have experience in the installation of structured cabling systems. All installers assigned by the Contractor to the installation work shall have factory certification that they are qualified to install and test the products provided.

C. Provide all test equipment used to conduct acceptance tests. Use only test equipment, which will produce a printed report of test results, which cannot be edited or manipulated by any means.

D. This Contractor shall furnish two (2) computer horizontal cabling network systems for the Campus Network and the Video Editing Network as described in these specifications and indicated on the drawings.

E. The contractor is to provide all materials, labor and equipment necessary to install conduit and wiring, anchors, hooks, and ladder racks required for a fully functioning computer network system when terminated to the main and intermediate distribution frames (MDF/IDF) hubs, servers, patch panels, computers or other system terminals.

F. Contractor shall warrant installation against all product defects, and that all approved cabling components meet or exceed the requirement of TIA/EIA-568A, TIA/EIA-568-A-A5, and ISAO/IEC 11801 for a period of one (1) year.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Network Cable and Jacks:
   1. COMCABLE
   2. GENERAL CABLE
   3. BELDEN

B. J-Hooks/Tri-hooks: Follow manufacturers printed instructions for installation. Support

cable bundles at 4 feet on center maximum. Do not exceed 50% of hook. Maximum fill-50 cat 6 equal to cpi Rapid Trak J hook w/Velcro strap p/n 31422-801. Tri-hook pn 31424-808 max fill-150 cat 6.

C. Cable pathway system – includes 10,000 series cable runway and all accessories. Equal to Chatsworth Product Incorporated, CPI.

D. Chatsworth Racks: Wall mounted enclosed 20U rack and a 2 post floor rack. Racks shall be 19" wide with E.I.A. Channel, equal to CPI. Provide with vertical and horizontal cable management.

E. General Note: For any device used for cable support, whether J-hook, caddy straps, or ladders racks, do NOT exceed 50% of support capacity. Product submittals must include cable loading capacity information.

F. Exposed wiring covers – All communications/computer wiring to be left exposed in rooms shall be enclosed in Panduit surface raceway system components. Provide Panway Type 'TM" raceway products and accessories as required to fully conceal wiring exposed in rooms. Mod-Com compatible. Submit colors for approval. Submit products for approval as equal. No adhesive back.

G. Provide fasteners compatible with cable support system products. All anchors and fasteners must be attached to building frame.

H. Patch Panels – Model ComCables 48 port, note Data, VOIP, and Security cable systems shall have its own patch panel, a minim of 3 patch panels for each data rack.

I. Outlets: Combination data/communications outlets on this Project shall be as follows:
   1. Krone True Net flush mount faceplate with high band RJ45 Key a tone jacks – 6 rated
   2. Color of telephone jack shall as noted. Color of faceplate shall be selected by the Architect.
   3. Faceplate labels (which designate network ID #) shall be marked as directed by the Owner.

PART 3 - EXECUTION

3.01 Provide factory bends for all elbows on conduit. Do not install more than two (2) 90 degree bends without installing a pullbox. For conduit runs longer than 100'-0", install a pullbox. Where routing is above an accessible ceiling, conduit may be stubbed out from the wall box and turned horizontal above the ceiling and terminated with plastic bushing to protect emerging cable.

3.02 Contractor shall guarantee labor and materials for one year from date of acceptance.

3.03 No LB conduits shall be allowed.

3.04 If pull boxes are installed, they must be large enough to maintain a minimum bending radius for cables.

3.05 A complete set of "contractor revised" drawings of installation shall be provided upon completion of project.

3.06 Backboxes shall be mounted at 18 inches above the finished floor unless noted otherwise on the drawings.

3.07 Installer shall maintain the minimum distance from sources of electromagnetic interference: 6 inches from power circuits; 1 foot from fluorescent and HID lamps; and 4 feet from transformers, meters and variable frequency drives.

3.08 All raceway elbows shall be long radius elbows.

3.09 Install conduit where cables, not in conduit, pass through floors. Extend conduit at least 6 inches above top of floor.

3.10 Plenum rated cables shall be installed regardless if they are installed in air plenums or not.

3.11 Cables shall be continuous, without splicing, from patch panels to outlets.

3.12 Do not peel back cable sheath more than necessary to separate conductors.

3.13 Do not score copper conductors when peeling back conductor insulation. Scored conductors shall be replaced.

3.14 Do not bend cables with a radius less than five times the cable's diameter. Cables bent with a radius less than this shall be replaced.

3.15 Kinked, torn, or twisted cable sheaths are unacceptable and will be replaced.

3.16 Install cables to avoid water, high humidity, chemicals, cold temperature bending, pair spreading, pair wrapping, and different lengths of pairs in same cable.

3.17 Do not bundle more than 216 four-pair cables or 36 twenty-five pair cables.

3.18 Make sure conduits are properly terminated, reamed and brushed before installation of cable(s).

3.19 Do not criss-cross pairs or allow them to become interwoven.

3.20 Verify proper conductor location at each termination before energizing.

3.21 Follow color code labels on individual pairs.

3.22 Cable sheaths shall be held in place by strain relief fittings.

3.23 Paint all junction boxes blue.

3.24 Bolt6 bottom of rack to floor and bolt top of rack to wall in accordance with Section 26 05 48.

3.25 Support all 2-1/2 inch or larger conduits and all cable trays in accordance with Section 26 05 48.

3.26 Install seismic flexible fitting on all 2-1/2 inch or larger conduits entering or leaving the building in accordance with Section 26 05 48.

3.27 Install outlets at 18 inches above finished floor to center of outlet, unless noted otherwise on the Drawings.

3.28 Install outlets 6 inches above finished countertops to center of outlet.

3.29 Maintain the following clearances to cables;

A. 6 inches from power circuits.

B. 12 inches from light fixtures.

C. 12 inches from hot water pipes, steam pipes and flues.

D. 48 inches from transformers, meters, VFD's, and power correction systems.

3.30 WIRE ROUTING PENETRATIONS

A. Provide by core drilling or other acceptable means a direct route between distribution frames and to individual devices to be served.
   1. Penetrations 1 inch and larger shall be sleeved.
   2. Grout sleeves in place using materials similar to wall construction.

B. Floor to floor penetrations should not exceed 4-inch diameter cleanly drilled and properly fire safed.
   1. Fire Safing:
      a. Install fire safing and sealant at all floor penetrations ad at the top of all fire-rated partitions.
      b. Install safing insulation and sealant at all cable penetrations and other pope through openings between floor and in fire walls.

   2. Materials:
      a. General: All products equal to "Therma Fiber" mineral fiber insulation as manufactured by USG Interiors, Inc., Chicago, Illinois.
      b. 4 inch thick, unfaced, mineral fiber insulation, regular color. Federal specification HH-1-558BB, Class 1.
      c. Sealing Compound: "Therma Fiber" smoke seal compound.

   3. Workmanship:
      a. Install in accordance with manufacturer's printed instructions.
      b. Stuff around wiring and wiring bundles passing through walls and floors full depth minimum 2 inches; top safing insulation with 2-inch-thick smoke seal compound.

3.31 Each network cable will be a home run from the room and each device to the intermediate distribution frame (IDF). Allow no splices between the IDF and the device served.

3.32 All cables exiting a room will be collected/bundled above corridor ceilings and travel along

corridors to the IDF.

3.33 Cable bundles containing more than four cables will be supported by J-hooks installed not more than 4 feet on center.

3.34 Owner to provide and install concentrators and all electronic equipment.

3.35 Contractor shall test and certify proper operation of computer network cables.

3.36 Install cables in ceilings in workmanlike manner to permit service, maintenance or replacement of adjacent equipment without disrupting the position of the network cables.

3.37 Cable bundles must be secured via Velcro straps, do not use tie wraps.

3.38 INSTALLATION AT THE MAIN DISTRIBUTION FRAME OR THE INTERMEDIATE DISTRIBUTION FRAME

A. Cables entering the MDF or IDF location will be placed on J hooks then ladder racks. Those devices will carry the network cable to the 19-inch racks where they will be terminated.

B. Materials the contractor will install shall include Chatsworth racks, ladder racks, patch panels and optical fiber boxes.

C. Terminate all network cables onto a patch panel. At patch panel terminations:
   1. Push pairs down in the cable slot against the block but not against the index strips.
   2. Keep pairs twisted up to termination.
   3. At patch panels, Velcro cable bundles.
   4. Terminate cabling to patch panels with lengths of cable sufficient to prevent binding on the brackets or angles of the rack.
   5. Provide a service ground at communication rack.

3.39 NETWORK CABLE IDENTIFICATION

A. Every network cable installed will be labeled at the jack and on the patch panel. No label will be handwritten. Lettering on label with be ¼ inch tall. Labels located on faceplates will be black letters on a clear tape.

B. Network cables will be labeled at the jack using the following system: IDF Floor. IDF Number. Patch Panel Letter. Patch Panel Port Number.

C. An example for the label on a jack located in the Business Building, on the third floor, in room 316 would be: 3.1.B.15.

D. Network Cables will be labeled on the patch panel with the room number the jack is terminated in.

E. Each network cable will be given a circuit ID.

F. The circuit ID will be assigned using the following system: Building Code. IDF Floor.

IDF Number. Patch Panel Letter. Patch Panel Port Number. Room number the jack is in.

G. An example for the circuit ID for a network line on the third floor of the Business Building would be: Building Number 3.1.B.15.316.

H. The circuit ID will be used to identify network cables on any reports or documentation supplied by the contractor.

3.40 DOCUMENTATION OF CABLE PATHS

A. Floor Plans:
   1. The contractor will be supplied with 2 sets of floor plans of each building.
   2. The contractor will be responsible for indicating J-Hook, cable trays, or conduit locations, network line paths, and optical fiber paths on one set of floor plans for each building in an organized and legible manner.

B. The contractor will return the marked floor plans to owner when each building is complete.

3.41 POST-INSTALLATION TEST AND CERTIFICATION

A. Quality Assurance:

B. The contractor shall provide sufficient skilled labor to complete testing with the agreed upon test period. Testing shall commence prior to owner's acceptance of a finished building.

C. The contractor shall have experience installing structured cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.

D. The contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.

E. The contractor is responsible for submitting acceptance documentation as defined below.

3.42 TEST PROCESS

A. The owner reserves the right to be present during any or all of testing.

B. Testing shall be of the Permanent Link. However, Contractor shall warrant performance based on Channel performance.

C. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the owner

D. 100% of the installed cabling must be tested. All tests must pass acceptance criteria.

E. Test equipment shall be fully charged prior to each days testing.

3.43 STANDARDS COMPLIANCE AND TEST REQUIREMENTS

A. Cabling must meet the indicated performance specifications:

Network line Specifications – Minimum Channel Standards		
Frequency	250MHz	
Length	295	or lower
Propagation Delay	72%	or higher
Delay Skew	45 ns	or lower
NEXT	35.4 dB	or higher
NEXT @ Remote	35.4 Db	or higher
Attenuation	31.5	or lower
ACR	1.4 dB	or higher
ACR @ Remote	1.4 dB	or higher
PSACR	.04 dB	or higher
PSACR @ Remote	.04 dB	or higher
RL	10 dB	or higher
RL @ Remote	11 dB	or higher
PSNEXT	34 dB	or higher
PSNEXT @ Remote	35 dB	or higher
ELFEXT	15.8 dB	or higher
ELFEXT @ Remote	15.8 dB	or higher
PSELFEXT	12.8 dB	or higher
PLELFEXT @ Remote	12.8 dB	or higher

3.44 TESTING

A. All documentation must be accompanied by a certificate signed by an authorized representative of the contractor and a current Registered Communications Distribution Designer (RCDD) warranting the truth and accuracy of the report.

B. All tests must be performed using a Fluke DSP 4300 meter using permanent link adapters or approved equal.

C. The contractor will ensure that each test performed has the correct network cable identification.

3.45 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and the owner is satisfied that all work is in accordance with contract documents, the owner shall notify Contractor in writing of formal acceptance of the system.

B. Acceptance Requirements:
   1. Contractor must warrant in writing that 100% of the installation meets the requirement specified under Standards Compliance and Test Requirements above.

C. Owner reserves the right to conduct, using his own equipment and labor, a random re-test

of up to five (5) percent of the cable plant to confirm documented results. Random re-testing can occur at any time during the warranty period. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during a re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the owner.

D. The owner may agree to allow certain cabling runs to exceed standardized performance criteria (e.g. length). In this event, such runs shall be explicitly identified, in writing, and excluded from requirements to pass standardized tests.

E. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% Pass rating, and receipt of full documentation as outlined by the owner.

END OF SECTION 27 00 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire alarm control panel.

B. Manual fire alarm stations.

C. Automatic smoke and heat detectors.

D. Fire alarm signaling appliances.

E. Auxiliary fire alarm equipment.

1.02 RELATED SECTIONS

A. Section 26 05 19 – Low-Voltage Electrical Power Connectors and Cable.

B. Section 23 09 23 - Automatic Temperature Controls.

C. Section 26 05 29 – Hangers and Supports for Electrical Systems.

D. Section 26 05 33 – Raceway and Boxes for Electrical Systems

E. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

F. Section 26 05 53 - Identification for Electrical Systems: Address directory and painted boxes.

1.03 REFERENCES

A. Americans with Disabilities Act.

B. Arkansas State Fire Protection Code.

C. ASME A17.1 - Safety Code for Elevators and Escalators.

D. International Building Code, 2021 Edition.

E. NFPA 70 - National Electrical Code.

F. NFPA 72 - National Fire Alarm Code.

G. NFPA 101 - Life Safety Code.

H. UL 228 - Door Closers - Holders, With or Without Integral Smoke Detector.

I. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.

J. UL 268A - Smoke Detectors for Duct Application.

K. UL 521 - Heat Detectors for Fire Protective Signaling Systems.

L. UL 864 - Control Units for Fire Protective Signaling Systems.

M. UL 753 - Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.

N. UL 1653 - Digital Alarm - Communicator System Units.

1.04 SYSTEM DESCRIPTION

A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to campus or remote monitoring station.

1.05 SUBMITTALS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Shop Drawings: Shop drawings shall be submitted to the Architect for approval prior to installation. The submittal shall include complete schematic circuit diagrams for all equipment, address device type, label and reference detail, wiring diagrams showing connections between all system components, description of system operation, annunciator schedule, and manufacturer's literature marked to show model and catalog number for all equipment. Complete riser diagrams indicating wiring sequence of all alarm devices and control equipment shall be included with the submittal data. Submittals shall be a complete set; partial submittals will not be accepted. Electrical drawings shall not be on less than 8-1/2 inch by 11 inch sheets, and shall identify all modules if so constructed, shall be on a single sheet drawings with all circuit terminals and inter-connections identified. Six (6) copies of the shop drawings shall be submitted.

C. Product Data: Provide electrical characteristics and connection requirements.

D. Test Reports: Indicate satisfactory completion of required tests and inspections.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1 and Section 26 05 00.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with experience.

B. Installer: Company specializing in installing the products specified in this section with experience, and certified by State of Arkansas as fire alarm installer.

C. The Arkansas Department of Labor requires that the worker, who installs the raceways for the equipment under this Section, be paid the electrician's minimum wage rate.

1.09 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70, NFPA 72 and NFPA 101.

B. Furnish products listed and classified by UL and/or FM as suitable for purpose specified and indicated.

C. The Arkansas Department of Labor requires that raceways, installed for equipment under this Section, be installed by licensed electricians.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of fire alarm system for one year from Date of Substantial Completion.

1.11 MONITORING SERVICE

A. Furnish monitoring service of fire alarm system for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - LIMITED TO THE FOLLOWING

A. Notifier.

B. FCI.

C. Simplex.

D. EST.

2.02 ALARM CONTROL PANEL

A. Control Panel: Modular construction with surface-mounted enclosure.

B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, relays, door holders, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes. Batteries shall

power door holders so that doors do not close upon loss of AC power.

C. System Supervision: Component or power supply failure places system in trouble mode.

D. Signaling Line Circuits: Shall consist of a shielded twisted pair wire, Class B, Style 4 circuit. T-taps are not allowed.

E. Notification Device Circuits: Supervised so that occurrence of a single ground or open condition places circuit in trouble mode but does not disable that circuit from signaling an alarm. Circuits shall be Class B, Style X for notification device circuits.

F. Municipal/Campus Trip Circuit: Output connections for remote station monitoring.

G. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

H. Provide TROUBLE ACKNOWLEDGE, ALARM ACKNOWLEDGE, SUPERVISORY ACKNOWLEDGE and ALARM SILENCE switch.

I. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:
   1. Visual and audible trouble alarm indicated by address at fire alarm control panel.
   2. Visual and audible trouble alarm indicated at remote annunciator panel.
   3. Trouble signal transmitted to campus connection where provided.
   4. Manual acknowledge function at fire alarm control panel silences audible alarm alarm, visual alarm is displayed until initiating failure or circuit trouble is cleared.
   5. Trouble conditions shall be reported to include device number, location and type of trouble.

J. Alarm Sequence of Operation: Actuation of any initiating device places system in trouble mode, which causes the following system operations:
   1. Report status of device and initiate alarm on device indicating circuits.

K. Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.

L. Lamp Test: Manual lamp test function causes alarm indication at each address, at fire alarm control panel and at annunciator panel.

M. Digital Communicator: Provide and install a digital communicator for remote station monitoring.

2.03 INITIATING DEVICES

A. Manual Pull Station: Addressable semi-flush and surface mounted, non-coded type, double action, breakglass type manual station with breakglass rod. Provide manufacturer's standard backbox. Simplex #2099-9795, addressable type.

B. Smoke Detectors: The smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use in open area protective coverage, in duct installation and duct sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system with 4 seconds. Detectors shall be programmable as application specific, selected in software for a minimum of 11 environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications caused by duct, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The system controlled output functions shall be from an individual or unique input of smoke obscuration, and thermal conditions. The detector shall designed to eliminate calibration errors associated with field cleaning of the chamber. The detector shall support the use of a relay and LED remote indicator at the same time. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling. Detector wiring shall not require any special shielded cable.

C. Duct Mounted Smoke Detector: Detectors shall be same as detector in Paragraph B above but shall be equipped with duct mounted housing and auxiliary contacts to shut down HVAC equipment.

D. Heat Detectors: Addressable type combination fixed temperature rate-of-rise type. Rate of rise selectable 15 degrees F or 20 degrees F per minute.

2.04 SIGNALING APPLIANCES

A. Alarm Lights: NFPA 72, UL 1971, Xenon, strobe lamp and flasher with minimum flash rate of 1 flash per second, red lettered "FIRE" on white lens. Units shall comply with A.D.A. requirements. Strobe candela ratings as shown on Drawings. All strobes shall be synchronized at 1 hertz.

B. Alarm Horn: NFPA 72, ANSI 117.1, surface and/or flush type fire alarm horn. Sound Rating: 95 dB at 10 feet (3M). Provide integral Xenon, strobe lamp and flasher with red lettered "FIRE" on white lens where indicated. Units shall comply with A.D.A. requirements.

C. Remote Annunciator: Minimum 40 character, back-lit, alphanumeric, liquid crystal display reports point status, type of alarm, number of alarms, supervisory conditions, troubles and custom location label. Simplex #4603-9101.

2.05 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 19.

B. Initiating Device and Indicating Appliance Circuits: Multiplex cable as recommended by manufacturer of fire alarm system. Cable shall be red.

C. All fire alarm wire and cable shall be installed in conduit as specified in Section 26 05 33.

2.06 INDIVIDUAL ADDRESSABLE MODULE

A. Provide location specific addressable to a single initiating device by monitoring N.O. dry contacts.

2.07 DOOR HOLDERS

A. Provide and install 24 volt DC door holders where indicated on the Drawings.

2.08 IP / CELLULAR FIRECOMMUNICATION

A. Communicator is connected to any Fire Alarm Control Panel DACT telephone ports, the system shall be capable of transmitting Contact ID formatted alarms, supervisory or troubles via Cellular dialer and Ethernet over a private or public WAN/LAN, Intranet or Ethernet.

B. Enclosures:
   1. Communicator shall be housed in a UL-listed cabinet. The back box and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.

C. Power Supply:
   1. The main power supply shall operate on 120 VAC, 60 Hz, 0.50Amp and shall provide all necessary power for the Communicator.
   2. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger. Battery arrangement may be configured in the field.
   3. The main power supply shall continuously monitor all field wires for earth ground conditions.

D. Batteries:
   1. Upon loss of Primary (AC) power to the Communicator, the battery shall have sufficient capacity to power the Communicator for required standby time (24 hours) followed by 5 minutes of alarm.
   2. The battery is to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install manual station with operating handle 4 feet above floor to center of device. Install audible and visual signal devices 80 inches above floor to bottom of device or 6 inches below ceiling to top of device, whichever is lower (unless noted otherwise on Drawings).

C. Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in conduit.

D. Mount end-of-line device in control panel.

E. Make conduit and wiring connections to sprinkler flow switches and sprinkler valve tamper switches.

F. Automatic Detector Installation: Conform to NFPA 72.

G. Duct detectors shall be interlocked with air handling unit starters to de-energize units upon activation of duct detectors. All associated smoke dampers shall be interlocked to close upon activation of duct detection. Fire alarm contractor shall install wire and conduit from duct detector to air handling unit starter. Fire alarm contractor shall connect wires to duct detector. Temperature controls contractor shall connect wires at motor starter. Both contractors shall test shut down.

H. Make conduit and wiring connections to smoke damper actuator controller.

I. Signal device shall sound different from other signal devices.

J. Bolt control panel to mounting surface in accordance with Section 26 05 53.

K. Door holders shall not release upon loss of AC power.

L. All wire and cables shall be installed in continuous conduit.

M. Do not peel back cable sheaths more than necessary to separate conductors.

N. Do not score copper conductors when peeling back conductor insulation. Scored conductors shall be replaced.

O. Do not bend cables with a radius less than five times the cable’s diameter. Cables bent with a radius less than this shall be replaced.

P. Kinked, torn or twisted cable sheaths are unacceptable and shall be replaced.

Q. Install cables to avoid chemicals and cold temperature bending.

R. Make sure conduits are properly reamed, terminated and brushed before installing cables or wire.

S. Verify proper conductor location at each termination before energization.

T. Maintain the following clearances to signal cables:
   1. 6 inches from power circuits other than fire alarm power circuits.
   2. 12 inches from light fixtures.
   3. 18 inches from hot water pipes, steam pipes and flues.
   4. 48 inches from transformers, meters and VFD's.

U. Paint all fire alarm boxes red where (1) concealed or (2) exposed in mechanical and electrical rooms.

V. Wall-mounted smoke detectors shall be installed with top of smoke detector between 4 inches and 12 inches down from ceiling or down from the deck where no ceilings exists.

W. Where there are exposed bar joists, smoke detectors shall be mounted on the bottom of the deck and shall not be mounted on the bottom of the open bar joists.

X. Where there are solid exposed joists, smoke detectors shall be mounted on the bottom of the joist and not on the ceiling or deck.

Y. Adjust door of control panel so that it opens easily without dragging.

Z. If control panel is less than 6'-6" tall, install panel with middle of panel at 48 inches. If panel is latter than 6'-6", install panel with top of panel at 7'-6".

AA. Install remote annunciators with middle of annunciator at 48 inches, unless mounted above a countertop.

BB. Install directory of addresses and corresponding devices and locations at control panel.

CC. Neatly form all wires and cables in control panel.

DD. Touchup scratched or marred surfaces to match original finish.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Test in accordance with NFPA 72 and local fire department requirements in the presence of the Owner's representative and the local fire marshal. Upon completion of successful test, the Contractor shall certify in writing to the Owner and General Contractor. Certificate of completion shall be prepared as required in NFPA 72. Contractor shall sign and date all pertinent information.

C. Check tightness of all conductor connections.

3.03 DEMONSTRATION

A. Provide a minimum of 6 hours of systems demonstration and training to Owner's designated representatives.

B. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.04 WARRANTY

A. The Contractor shall warranty the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA 72 guidelines. Provide smoke detector inspection forms to Owner with information as outlined in NFPA 72.

C. A fire alarm certificate of completion form shall be issued to the Owner with all required information as outlined in NFPA 72.

END OF SECTION 28 31 00

PART 1 - GENERAL

1.01 SUMMARY

A. Perform earthwork.

B. Meet requirements for excavation safety, or to facilitate construction due to wet conditions.

C. Perform excavation regardless of type, nature, or condition of materials encountered.

D. Contractor shall make his own estimate of the type and extent of the various materials to be excavated in order to accomplish the work.

E. There will be no extra compensation for dewatering.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling.

1.03 REFERENCES

A. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959 USA Phone: (610) 832-9585 Fax: (610) 832-9555.
   1. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb Rammer and 12-in. Drop.
   2. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18-in. Drop.
   4. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
   5. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place of Nuclear Methods (Shallow Depth).

B. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P: Excavations.

C. Arkansas Statute 291 of 1993.

1.04 DEFINITIONS

A. Relative Compaction:
   1. The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable.
   2. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer.

B. Optimum Moisture Content:
   1. Moisture content of the material for which the maximum dry density is obtained as determined by ASTM D698 or D1557.
   2. Field moisture contents shall be determined on the basis of the fraction passing the 3/4-inch sieve.

C. Completed Course: A course or layer that is ready for the next layer or the next phase of construction.

1.05 SUBMITTALS

A. Submit in accordance with specifications.

B. Provide the following:
   1. Samples of imported material.
   2. Samples of onsite material to be used as fill.
   3. Certification that imported materials conform to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory.
   4. Proctor curves on fill material as prepared by approved laboratory.

1.06 PROJECT CONDITIONS

A. Beginning work of this Section means acceptance of existing conditions.

PART 2 - PRODUCTS

2.01 FILL

A. Free from roots, organic matter, trash, and debris with maximum particle size of 1-1/2 inches.

B. It is intended that structural backfill material be obtained from on site to the maximum extent possible.

C. Existing concrete moat material: the crushed concrete, less reinforcement steel, may be reused for fill material. The crushed concrete should be processed to a “reasonably well-graded” mix with a maximum size of 2 inches.

2.02 TOPSOIL

A. Selected topsoil at the site, properly stored and protected, free from roots, sticks, hard clay, and stones which will not pass through a 2-inch square opening.

B. Provide imported topsoil of equal quality if required to accomplish the work.

2.03 COMPACTION EQUIPMENT

A. Provide compaction equipment of suitable type and adequate to obtain the densities specified.

B. Operate compaction equipment in strict accordance with the manufacturer's instructions and recommendations.

C. Hand-operated equipment shall be capable of achieving the specified densities.

2.04 MOISTURE CONTROL EQUIPMENT

A. Provide equipment for applying water of a type and quality adequate for the work; it shall not leak; and be equipped with a distributor bar or other approved device to assure uniform application.

B. Provide equipment for mixing and drying out material consisting of blades, discs, or other approved equipment.

2.05 WATER REMOVAL EQUIPMENT

A. Provide and operate equipment adequate to keep excavation and trenches free of water.

2.06 IMPORTED MATERIAL ACCEPTANCE

A. Import only if insufficient material is available on-site.

B. Locate and arrange use of a site near the construction area for obtaining borrow material.

C. Additional tests required at the borrow area:
   1. Standard Proctor.
   2. Remolded permeability.
   3. Atterberg limits.

D. Cost for testing and imported material shall be the responsibility of the Contractor.

2.07 SELECTED MATERIAL ACCEPTANCE

A. Provide samples for testing representative of the actual material to be installed in the work. Take samples from each 2,000 cubic yards of material stockpiled. Depending on the uniformity of the material, Engineer may request more frequent samples.

B. Forward test results to the Engineer at least 10 days before the material is required for use. If tests indicate that the material does not meet Specification requirements, the material shall not be installed in the work.

C. Material which is placed in the work but does not conform to the Specification requirements shall be removed and replaced at the Contractor's sole expense.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Clearing and grubbing is not required on this project.

3.02 STRIPPING TOPSOIL

A. Remove existing grass and overburden before excavating topsoil.

B. Prior to beginning excavation or fill, strip the topsoil to a depth of at least 6 inches or to a depth sufficient to remove organic material and stockpile for future use.

C. In general, remove topsoil where structures are to be built, trenches dug, and similar improvements constructed within the areas presently covered with topsoil.

D. Store topsoil clear of the construction area.

E. Take reasonable care to prevent the topsoil from becoming mixed with subsoil or eroding.

3.03 STRUCTURAL EXCAVATION

A. Contractor shall be solely responsible for trench and excavation safety systems in accordance with ACT 291 of 1993 and OSHA requirements.

B. Identify required lines, levels, and grades.

C. Identify known underground utilities. Contractor will be responsible for locating utilities.

D. The method of excavation is optional, however, no equipment shall be operated in a manner that will endanger existing structures and their integrity.

E. Use excavation support system such as sheet piling where ever necessary.

F. Allow for forms, working space, granular base, and finish topsoil where shown on Drawings or required.

G. Do not carry excavation for footings and slabs deeper than the elevation shown on Drawings after allowing for base material. Excavation of material to depths below the grades indicated, unless so directed by the Engineer or Owner’s representative, will be deemed unauthorized excavation.

H. If undercutting occurs below the planned dirt grade, the same fill material as specified for backfill shall be placed and compacted to 100 Percent Standard Proctor Density as defined in this Section up to the planned dirt grade in 8 inch lifts, at no additional cost to the Owner. Do not attempt to over compact excessively wet soil. Allow to dry first by scarifying and aerating before remolding.

3.04 DEWATERING EXCAVATION

A. Remove water during periods when concrete is being deposited, pipe is being laid, and placing of backfill unless water settling is required, and at other times as required for efficient and safe execution of the work.

B. Accomplish removal of groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures.

C. Where necessary to these purposes, lower the water level in advance of excavation, utilizing wells, well points, or similar methods.

D. Maintain the water level in the gravel stratum as measured in piezometers, a minimum of 3 feet below the prevailing excavation level or as needed to prevent bottom heave of the excavation.

E. Open pumping, sumps, and ditches: If these result in boils, loss of fines, softening of the ground or instability of slopes, areas shall not be accepted.

F. Install wells and well points with suitable screens and filters so that continuous pumping of fines does not occur.

G. Operate well points continuously to prevent boils and loss of consolidation.

H. Arrange discharge to facilitate collection of samples by Engineer.

I. Avoid settlement or damage to adjacent property.

J. Dispose of water in a manner that will not damage adjacent property, as approved.

3.05 FILL MATERIAL UNDER FACILITIES

A. Place fill material as specified in this Section within the influence area beneath slabs, and structures, and as shown on the Drawings.

B. Do not exceed loose lifts of 6 inches.

C. Compact each lift to not less than 95 Percent Modified Proctor Density.

D. Place and compact a 6-inch layer of granular fill to at least 95 Percent Modified Proctor density immediately beneath spread footings, slabs on grade, or other concrete structures.

E. Moisten material as required to aid compaction (± 2 percent optimum moisture).

F. Place material in horizontal lifts and in a manner to avoid segregation.

G. Correct and repair subsequent damage to slabs, piping, concrete structures, facilities, or other structures caused by settlement of fill material.

3.06 BACKFILL AND STRUCTURES

A. Remove form materials and trash from excavation before placing backfill.

B. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material.

C. Compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.

D. Backfill water-holding basins only after satisfactory leakage tests have been conducted.

E. Place earth fill in areas not designated to be structural fill or granular fill.

F. Deposit material in maximum 6-inch loose lifts, and compact each lift to not less than 95 Percent Standard Proctor.

3.07 FILL NOT BENEATH STRUCTURES OR FACILITIES

A. Place earth fill to the lines and grades shown.

B. Place fill material in maximum 6-inch loose lifts and compact each lift to not less than 95 Percent Standard Proctor.

C. Make proper allowance for topsoil where required.

3.08 MOISTURE CONTROL

A. During compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill.

B. Maintain moisture content uniform throughout the lift.

C. Add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill.

D. At the time of compaction, maintain the water content of the material at optimum moisture content, plus or minus 2 percentage points, except as otherwise specified for embankments.

E. Do not attempt to compact fill material that contains excessive moisture.

F. Aerate material by blading, discing, harrowing, or other methods, to hasten the drying process.

3.09 FIELD DENSITY TESTS

A. Test Methods: ASTM D2922, D1556, D2216, and D3017.

B. Cooperate with testing work by leveling small test areas designated by the Engineer.

C. Backfill test areas.

D. Field density test shall be performed for fill material placed on each side of the box culverts.

E. Engineer may order testing of lift of fill at any time, location, or elevation.

3.10 SITE GRADING

A. Perform earthwork to lines and grades as shown on Drawings with proper allowance for topsoil where specified or shown on Drawings.

B. Shape, trim, and finish slopes to conform with the lines, grades, and cross sections shown.

C. Slopes shall be free of loose exposed roots and stones exceeding 1½-inch diameter.

D. Round tops of banks to circular curbs, in general, not less than a 6-foot radius.

E. Neatly and smoothly trim rounded surfaces; over-excavating and backfilling to the proper grade are not acceptable.

F. Finished site grading shall be reviewed by the Engineer.

3.11 DISPOSAL OF EXCESS EXCAVATION

A. Dispose of excess excavated materials, not required or suitable for use as backfill or fill off site.

3.12 SETTLEMENT

A. Settlement in backfill, fill, or in structures built over the backfill or fill, that may occur within the 1-year guarantee period in the General Conditions shall be considered to be caused by improper compaction methods.

B. Restore structures damaged by settlement to original condition.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Earthwork for this project includes but is not necessarily limited to:
   1. Layout of building and site improvements.
   2. Excavating for foundations, utilities and other below grade work.
   3. Filling and backfilling of all excavations.
   4. Rough and finish grading of the site.
   5. Granular drainage fill.

B. Perform excavation regardless of type, nature or condition of materials encountered.

C. All excavation under this Section is unclassified and no allowances will be made for nature of material encountered. Contractor shall make soil investigations as he considers necessary for his own determination of types of materials existing at the site. Refer to Section 00 31 32 for information concerning Geotechnical Investigation.

D. There will be no extra compensation for dewatering.

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.
   1. Samples of all imported material. Provide 25 pound bags of material to Geotechnical engineer's office at least 10 days before the material is to be imported to the site.
   2. Samples of all on-site material to be used as fill.
   3. Certification that imported materials conform to the specification requirements along with copies of the test results from a qualified commercial testing laboratory.
   4. Proctor curves on fill material as prepared by approved laboratory.

B. All fill material requires approval prior to placement.

C. Substitutions will not be considered prior to the award of the General Contract.

1.04 JOB CONDITIONS

A. Beginning work of this Section means acceptance of existing conditions.

B. Dust Control: Control dust on and near the Work if dust is caused by Contractor's operations during performance of the Work or if resulting from condition in which Contractor leaves the site.

1.05 REFERENCES

A. Arkansas State Highway and Transportation Department, Standard Specifications for Highway Construction, latest edition.
   1. AHTD Section 207 - Stone Backfill.
   2. AHTD Section 303 - Aggregate Base Course.

B. ASTM International, 100 Barr Harbor drive, PO Box C700, West Conshohocken, PA 19428-2959, USA Phone: (610) 832-9585.
   1. ASTM D698 - Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. Rammer and 12 in. Drop.
   2. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18 in. Drop.
   4. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil-Aggregate Mixtures.
   5. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   7. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

C. AASHTO - American Association of State Highway and Transportation Officials
   1. AASHTO T 27 - Sieve Analysis of Fine and Coarse Aggregates.

D. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P = Excavations.

E. Arkansas Statute 291 of 1993.

1.06 DEFINITIONS

A. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Architect.

B. Optimum Moisture Content: Moisture content of the material for which the maximum dry density is obtained as determined by ASTM D698 or D1557. Field moisture contents shall be determined on the basis of the fraction passing the 3/4" sieve.

C. Completed Course: A course or layer that is ready for the next layer or the next phase of construction.

D. Under-Cut: Additional excavation into native soils beyond sub-grade or stripping depth that is required to provide an adequate depth of suitable backfill bearing material.

E. Sub-grade: The following shall define the sub-grade elevations:
   1. Footings: The elevation of the bottom of the footing.
   2. Building slabs: The elevation at the bottom of the capillary break.
   3. Walkways and Paving: The elevation at the bottom of the paving section.
   4. Utility Trenches: The elevation of the bottom of the pipe bedding.
   5. Landscaped Areas: The elevation below the stripping depth or the soil planting section, whichever is lower.

F. Unsuitable material shall be that material below the sub-grade elevation that does not meet bearing capacity requirements as defined by the field Geotechnical engineer. Material not previously approved by Geotechnical engineer as unsuitable will not be considered for compensation.

1.07 UNSUITABLE MATERIAL

A. The Contractor will be compensated beyond his base bid for excavation and off-site disposal of un-anticipated unsuitable soils only as verified and documented by the Geotechnical engineer in the field. No compensation will be made to the Contractor for unverified and undocumented quantities.

B. Measure in-place bank yards of material that is to be removed by field measurement that shall be observed, verified, and documented by the Geotechnical Engineer prior to backfilling with imported Granular fill. Measurement by truck tickets will not be accepted. Measurement of excavation prior to backfilling will also be used to determine the quantity of excess import required to replace the excavated material.

C. Soil integrity will be influenced by the weather conditions and the Contractor's handling and protection of the material as it is removed and placed. It is the sole responsibility of the Contractor to protect soils from the elements. The Contractor will be responsible for removing material, including previously inspected fill or exposed sub-grade, that is deemed unsuitable due to lack of protection and replacing with acceptable material at no additional cost to the Owner.

D. Compensation will not be made for material that was not defined and verified in the field as unsuitable material by the Geotechnical engineer.

PART 2 - PRODUCTS

2.01 EARTH FILL

A. Place earth fill in areas not designated to be structural fill or backfill.

B. Free from roots, organic matter, trash and debris with maximum particle size of 1-1/2 inches.

C. Imported fill is to consist of clayey sand (SC), sandy clay (CL) or clayey gravel (GC).

D. Alternate materials having a liquid limit not greater than 45 and approved by the Architect.

D. Engineered fill is to consist of approved low volume-change material designated as CL or GC soils having a Liquid Limit less than 40 and a Plasticity Index less than 20 or Class 7 Aggregate Base Course.

E. It is intended that fill be obtained from the site excavation to the maximum extent possible. DO NOT CONSTRUCT BORROW PITS ON SITE WITHOUT WRITTEN AUTHORIZATION FROM THE ARCHITECT.

2.02 STRUCTURAL (FLOWABLE) FILL

A. Imported structural fill, Controlled Low Strength Material (CLSM), is to consist of a natural or artificial mixture of sand, course aggregate, cement and water, uniformly well graded from coarse to fine. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics. Conform to ASTM D4832.

B. Conform to the AHTD Section 303 classifications for Class 3, Class 4 or Class 7 as as required by existing soil conditions.

2.03 UNDERSLAB DRAINAGE FILL

A. Crushed stone or washed gravel, uniformly graded from 3/4" minimum size to 1-1/2" maximum size (ASTM C-33 #57 or equivalent).

2.04 CRUSHED SYENITE FILL

A. Fill and Backfill Inside Building Walls: Crushed syenite, similar to Donna-Fill. Deliver to job in moist condition. Settle in place by completely immersing under water for optimum compaction. Keep water level above syenite at all times during placing.

2.05 TOPSOIL

A. Selected topsoil from the site, properly stored and protected, free from roots, sticks, hard clay and stones which will not pass through a 1 in. square opening. Provide analysis of topsoil to ascertain percentage of nitrogen, phosphorus, potash, soluble sale content, organic matter content, and pH value.

B. Provide imported topsoil of equal quality if required to accomplish the work.
   1. Natural, fertile, friable soil, possessing characteristics of representative productive soils in the vicinity. Obtain from naturally well-drained areas, without admixture of subsoil and free from Johnson grass (sorgam halepense), nut grass (cyprus rotundus), and objectionable weeds and toxic substances. Topsoil furnished shall be free from trash, brush, and stones over 1 inch in diameter, and related extraneous material.
   2. Provide to Architect soil analysis including analysis for noxious weeds, nematodes, organic content and foreign matter. Conduct analysis using methods approved by the Association of Official Agricultural Chemists of the State Agricultural Experiment Station.
   3. Preliminary soils test may be conducted by Contractor for conditional acceptance by Architect. Shipping and delivery of topsoil may begin after acceptance of preliminary test findings, when acceptable. Conduct additional soils tests specified in soils testing lab.

C. **Topsoil Removal:** Prior to the commencement of construction, the site shall be cleared of all vegetation in construction areas. After the site is cleared, all topsoil shall be stripped from the site and an adequate amount stored (4 inch minimum thickness) for reuse on the site for final seeding or landscaping. Excess topsoil may be used on embankment slopes or excavated slopes after final compaction of the embankment material or back-slopes. No topsoil shall be placed in areas to receive pavement, sidewalks or structures. Topsoil, because of its compressible organic content, shall not be used in areas that will support embankments, structures, or pavements. See Geotechnical Report for approximate stripping depths required.

2.06 COMPACTION EQUIPMENT

A. Provide compaction equipment of suitable type and adequate to obtain the densities specified.

B. Operate compaction equipment in strict accordance with the manufacturer's instructions and recommendations.

C. Maintain equipment in such condition that it will deliver the manufacturer's rated compactive effort.

D. Hand operated equipment shall be capable of achieving the specified densities.

2.07 MOISTURE CONTROL EQUIPMENT

A. Provide equipment for applying water of a type and quality adequate for the work; it shall not leak and shall be equipped with a distributor bar or other approved device to assure uniform application.

B. Provide equipment for mixing and drying out material consisting of blades, discs or other approved equipment.

2.08 WATER REMOVAL EQUIPMENT

A. Provide and operate equipment adequate to keep excavation and trenches free of water. including but not limited to pumps and hoses.

2.09 SELECTED MATERIAL ACCEPTANCE

A. Provide samples for testing representative of the actual material to be installed in the work. Take samples from material stockpiled. Depending on the uniformity of the material, Architect may request additional samples.

B. Tests required at the borrow area:
   1. Standard Proctor.
   2. Atterberg limits.

C. Forward test results to Architect at least 10 days before the material is required for use. If tests indicate that the material does not meet specification requirements, the material shall not be installed in the work.

D. Material which is placed in the work but does not conform to the specification requirements shall be removed and replaced at the Contractor's expense.

2.10 AGGREGATE SURFACING

A. Provide Class 7 Base (SB-2) – 1.5" minus w/fines.

B. SB-2 is similar to limestone base but is harder, less dusty and less susceptible to tracking. It is primarily used in driveways, pathways, road bases, parking lots and pipe bedding. Excellent wet weather product.

C. Provide Class 8 Base – 1" minus w/fines. This product has the same uses as Class 7 (SB-2).

2.11 OTHER MATERIALS

A. Provide materials, not specifically described but required for proper completion of work of this Section, selected by Contractor subject to Architect approval.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Complete clearing and grubbing work as specified in Section 02 41 13 prior to beginning work in this section.

3.02 LAYOUT AND STAKING

A. The Contractor will employ and pay a competent, independent, Registered Professional Land Surveyor with demonstrated ability to perform the layout work required.

B. Definitions
   1. "Control Stakes" are the original reference points set by Engineer for the construction work.
   2. "Construction Staking" is an additional staking required as the project progresses which is the responsibility of Contractor.

C. Engineer shall provide the following staking:
   1. Set temporary bench marks.
   2. Reset stakes found to be in error.

D. Contractor shall provide the following staking:
   1. All construction staking except as provided by Engineer above.
   2. Reset stakes, marks or pins lost due to Contractor's operations.

E. Electronic copies of surveying staking points will not be made available for this project.

F. Control Staking
   1. Notify Engineer, in writing, at least five days in advance of the date when control staking services are desired.
   2. Engineer shall provide control staking.
   3. Examine stakes before commencing operations.
   4. Notify Engineer if validity of any control stake is questionable.
   5. Engineer will check stake or stakes in question.
   6. Any control stakes found to be in error will be reset by Engineer.
   7. If stakes are valid, Contractor shall pay for cost of checking stakes.
   8. Contractor shall inform his employees, subcontractors and vendors of importance of control stakes and the necessity of their preservation.
   9. Contractor shall pay for resetting any control stakes, marks, or pins lost due to Contractor's operations.

G. Construction Staking
   1. Provide all construction staking as needed to complete the Work.

H. If site conditions vary from those indicated, the Contractor shall notify the Architect immediately.

3.03 STRUCTURAL EXCAVATION

A. Excavate subsoil required for building foundations both interior and exterior, construction operations and other work. Excavate for structures to the lines and grades shown or as required to accomplish the construction.
   1. After excavating footings and prior to placing any fill material, Contractor is to arrange for qualified testing agency to perform hand held penetrometer tests at 10 foot intervals along entire length of perimeter footing and along all interior grade beams to determine that minimum soil bearing capacity has been achieved.

B. The method of excavation used is optional; however, no equipment shall be operated within 5 feet of existing structures or newly completed construction.

C. Excavation that cannot be accomplished without endangering present or new structures shall be done with hand tools.

D. Machine slope banks to angle of repose or less until shored.

E. Excavate to the depths and widths required.

F. Do not interfere with normal 45 degree bearing splay of foundations.

G. Allow for forms, working space, granular base and finish topsoil.

H. Do not carry excavation for footings and slabs deeper than the elevation shown.
   1. Fill over excavations under footings with concrete of equal strength to that of the footing when excavations are deeper than the elevation shown.
   2. Replace excavation carried below the grade lines shown or established by the Architect with the same fill Material as specified for the overlying fill or backfill, compact as required for such overlying fill or backfill.
   3. Where the overlying area is not to receive fill or backfill, replace the over excavated material and compact to a density not less than that of the underlying ground.
   4. Correct over excavated areas and unauthorized excavation at the Contractor's expense.

I. Correct cuts below grade by similarly cutting adjoining areas and creating a smooth transition.

J. Hand trim excavation and leave free of loose matter.

K. Remove lumped subsoil, boulders and rock.

L. Stockpile excavated material in area designated on site and remove excess subsoil not being reused from site.

3.04 EXCAVATION SAFETY

A. The Contractor shall be solely responsible for making the excavation in a safe manner.

B. Provide appropriate measures to retain excavation side slopes to ensure that men working in or near the excavation are protected.

3.05 DEWATERING EXCAVATION

A. Remove water during periods when concrete is being deposited, pipe is being laid and placing of backfill unless water settling is required and at such other times as required for efficient and safe execution of the work.

B. Accomplish removal of groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes and will not result in damage to existing structures.

C. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints or similar methods.

D. Maintain the water level in the gravel stratum as measured in piezometers, a minimum of 3 feet below the prevailing excavation.

E. Open pumping, sumps and ditches: If these methods result in boils, loss of fines, softening of the ground or instability of slopes, they will not be permitted.

F. Install wells and wellpoints with suitable screens and filters so that continuous pumping of fines does not occur.

G. Operate well points continuously so as to prevent boils and loss of consolidation.

H. Arrange discharge to facilitate collection of samples by Architect.

I. Avoid settlement or damage to adjacent property.

J. Dispose of water in a manner that will not damage adjacent property, as approved by Architect.

3.06 UNDERCUTTING

A. Undercut areas on the site that do not meet the permeability requirements to such depth as to allow placement of sufficient impervious material as determined by permeability testing at borrow area as stated in Part 2 of this section.

B. Prior to placement of fill in the undercut area, scarify the upper 6" of subgrade and re-compact to 95 percent of ASTM D1557 or as recommended by the geotechnical report.

3.07 FOUNDATION SUBGRADE PREPARATION

A. After completion of excavation and prior to foundation or fill construction, proofroll the excavation surface with a loaded tandem-axle dump truck or similar heavy wheeled vehicle to detect soft or loose zones.

B. Conduct proof-rolling in the presence of Architect.

C. If soft or loose zones are found, excavate the material to a depth accepted by Architect, then fill and compact as specified for the overlying fills.

D. Prior to placement of overlying fill or concrete, scarify the upper 6" of subgrade and re-compact the foundation subgrade to at least 95 percent of ASTM D1557 or as recommended by the geotechnical report.

3.08 FILL MATERIAL

A. Place structural fill material within the influence area beneath all piping, slabs, structures and other areas of excavation.

B. Place fill in 6" loose lifts and compact each lift to 95 percent of ASTM D1557 or as recommended by the geotechnical report.

C. Moisten material as required to aid compaction (+ or - 2 percent optimum moisture content).

D. Place material in horizontal lifts and in a manner which avoids segregation.

E. Correct and repair subsequent damage to slabs, piping, concrete structures, facilities or other structures caused by settlement of fill material.

3.09 BACKFILL

A. Remove form materials and trash from excavation before placing backfill.

B. Do not operate earth moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material.

C. Compact backfill adjacent to concrete walls with hand operated tampers or similar equipment that will not damage the structure.

D. Place backfill material in 6" loose lifts and compact each lift to 95 percent of ASTM D1557 or as recommended by the geotechnical report.

E. Backfill all utility excavations and compact to minimum 95 percent of ASTM D698.

3.10 SUBGRADE PREPARATION AND FILL MATERIAL AT PAVED AREAS

A. Paved areas include areas to receive Gravel Surfacing, Asphalt Concrete Paving, Portland Cement Concrete Paving, etc.

B. Scarify upper 6" of natural subgrade and recompact to 90 percent of ASTM D1557 or as recommended by the geotechnical report.

C. Place structural fill material to the lines and grades shown in maximum 6" loose lifts and compact each lift to not less than 90 percent of ASTM D1557 or as recommended by the geotechnical report.

3.11 MOISTURE CONTROL

A. During compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill.

B. Maintain moisture content uniform throughout the lift.

C. Add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill.

D. At the time of compaction, maintain the water content of the material at optimum moisture content, plus or minus 2 percent, except as otherwise specified for embankments.

E. Do not attempt to compact fill material that contains excessive moisture.

F. Aerate material by blading, discing, harrowing or other methods to hasten the drying process.

3.12 FIELD DENSITY TESTS

A. Test Methods: ASTM D2922, D2216 and D3017.

B. Cooperate with testing work by leveling small test areas designated by the Architect.

C. Backfill test areas.

D. Field density test shall be performed for every 50 cubic yards of fill material placed.

E. Architect may order testing of any lift of fill at any time, location or elevation.

3.13 FINISH SITE GRADING AND TOPSOIL PLACEMENT

A. **Finished Grading:** After all structures have been completed and all backfills have been compacted, all areas on the project construction site which have been disturbed by

the Contractor shall be brought to true grade with a minimum of 4 inches of topsoil. Perform earthwork to lines and grades as shown with proper allowance for topsoil.

B. Provide a minimum 4" depth of topsoil in all areas within the limits of construction that are disturbed during the course of this work except areas that are to receive sod or paving material.

1. Areas To Receive Sod: After subgrade preparation, furnish, place, and spread 3" minimum thickness of topsoil over earth areas to be sodded. Do not spread topsoil in frozen or muddy condition. Make allowance for settlement to obtain 3" finished full depth of topsoil. Till thoroughly areas where existing topsoil has not been removed to depth of at least 3" until condition of soil is friable and of uniform texture. Remove stones over 1" in diameter, sticks, and rubbish.

C. Shape, trim and finish slopes to conform with the lines, grades and cross sections shown.

D. Make slopes free of loose exposed roots and stones exceeding 3 inches in diameter.

E. Round tops of banks to circular curves, in general, not less than a 6 foot radius.

F. Neatly and smoothly trim rounded surfaces; over excavating and backfilling to the proper grade are not acceptable.

G. Finish site grading will be reviewed by Architect.

3.14 DISPOSAL OF EXCESS EXCAVATION

A. Dispose of excess excavated materials, not required or suitable for use as backfill or fill off-site.

B. Compact excess material as specified for fill, dress the completed disposal area to slopes no greater than 4:1 (horizontal:vertical) and slope to drain.

3.15 SETTLEMENT

A. Settlement in backfill, fill or in structures built over the backfill or fill, which may occur within the 1-year guarantee period in the General Conditions will be considered to be caused by improper compaction methods.

B. Restore structures damaged by settlement to original condition.

END OF SECTION 31 00 10

PART 1 - GENERAL

1.01 SUMMARY

A. Remove interfering or objectionable material from designated areas of Work.

B. Preserve vegetation and existing objects designated to remain from injury or defacement.

C. Cut trees only at direction of Engineer.

D. Contractor shall be responsible for implementing and following a Storm Water Pollution Prevention Plan as required by the Arkansas Department of Environmental Quality and in accordance with NPDES ARR150000. The successful Bidder (Contractor) shall develop a Storm Water Pollution Prevention Plan to meet all State and Federal regulations and submit to the Engineer for review and approval prior to commencing work.

1.02 DEFINITIONS

A. Clearing:
   1. Cutting, removing, and disposing of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth.
   2. Removing evidence of their presence from the surface, inclusive of sticks and branches greater than 2 inches in diameter or thickness.
   3. Removing and disposing of trash piles, rubbish, and fencing.

B. Grubbing:
   1. Removing and disposing of wood or root matter below the ground surface remaining after clearing.
   2. Includes stumps, trunks, roots, or root systems greater than 2 inches in diameter or thickness to a depth of 18 inches below the ground surface.

C. Stripping: Removing and disposing of organic sod, topsoil, grass and grass roots, and other objectionable material from the areas designated to be stripped that remain after clearing and grubbing.

PART 2 - MATERIALS

2.01 GENERAL

A. Provide materials, suitable and in adequate quantity, required to accomplish Work of this Section.

PART 3 - EXECUTION

3.01 PREPARATION

A. Review with Engineer's representative the location, limits, and methods to be used prior to commencing Work under this Section.

3.02 CUTTING TIMBER

A. Exercise care when clearing near the clearing limits to avoid damage to existing trees, vegetation, structures, or utilities which are outside of the clearing limits.

B. Trees shall be leveled into the area to be cleared.

C. Flush cut stumps not designated for grubbing by cutting to within 2 inches of the ground surface.

D. Timber is the property of the Contractor.

E. Dispose of stumps, limbs, brush, snags, non-marketable timber, and other vegetative growth off-site.

3.03 PRESERVATION OF TREES, SHRUBS, AND OTHER VEGETATION

A. Trees, shrubbery, and other vegetation not designated for removal shall be protected from damage.

B. Cut and remove tree branches only where, in the opinion of the Engineer, cutting is necessary to effect construction operation.

C. Remove branches other than those required to effect the Work to provide a balanced appearance of any tree, as approved prior to removal.

D. Treat scars resulting from the removal of branches with an approved tree sealant.

3.04 CLEARING AND GRUBBING LIMITS

A. Clear and grub areas within the limits of construction.

B. Clear and grub in stages as the construction area is increased to avoid unnecessary clearing and grubbing.

3.05 DISPOSAL OF CLEARING AND GRUBBING DEBRIS

A. Haul the material from the Work site and dispose of in accordance with state, federal, and local laws. Off-site disposal shall be at the Contractor's sole expense.

3.06 AREAS TO BE STRIPPED

A. The exact depth of stripping shall be determined by the Engineer.

B. Topsoil requirements are specified in Section 31 00 00.

C. Strip areas that are cleared and grubbed.

D. Strip areas in stages to avoid unnecessary stripping.

3.07 DISPOSAL OF STRIPPINGS

A. Do not mix strippings with borrow excavation.

B. Stockpile topsoil from the strippings for use in landscape grading.

C. Dispose of excess topsoil.

D. Strippings not suitable for use as topsoil shall become the property of the Contractor and shall be removed from the site.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Work of this Section also includes:
   1. Replacing topsoil that contains regenerative material.
   2. Disposal of trees, stumps, brush, roots, limbs, and other waste materials from clearing operations.
   3. Imported topsoil.
   4. Crush rock backfill required by over-excavation.
   5. Imported pipe zone material.
   6. Trench settlement repair, including replacing roadway surfacing, sidewalk, or other structures.
   7. Replacing damaged culverts.

B. Trench excavation is classified as common excavation and includes removal of material of whatever types encountered including rock to depths shown or as directed by Engineer.

C. Pipe zone includes full width of excavated trench from bottom of pipe to a point 6 inches above top outside surface of pipe barrel.

D. Conform to federal, state, and local codes governing safe loading of trenches with excavated material.

E. The right is reserved to modify the use, location, and quantities of the various types of backfill during construction as Engineer considers to be in the best interest of Owner.

F. There shall be no extra compensation for dewatering and rock excavation. Rock excavation shall be quantified by the geotechnical testing agency and shall be paid per the unit price given.

1.02 RELATED SECTIONS

A. Section 31 25 00 - Erosion and Sedimentation Controls.

1.03 REFERENCES

A. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
   1. ASTM D448 - Classifications for Standard Sizes of Aggregate and Bridge Construction.
   2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. (2.49-kg.) Rammer and 12-inch (304.8-mm) Drop.

3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10-lb. (4.54-kg.) Rammer and 18-inch (457-mm) Drop.
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes.
5. ASTM D2922 - Test Methods for Density of Soils and Soil-Aggregates in Place by Nuclear Method.

B. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P: Excavations.

C. The Contractor shall be solely responsible for trench and excavation safety systems in accordance with Act 291 of 1993.

PART 2 - PRODUCTS

2.01 FOUNDATION STABILIZATION

A. Crushed gravel or crushed rock, free from dirt, clay balls, or organic material, well graded from coarse to fine, containing sufficient finer material for proper compaction, and meeting ASTM D448 Size No. 67 (Concrete Aggregate).

2.02 PIPE ZONE MATERIAL

A. Select material shall consist of fine loose earth or sand free from clods or rocks larger than 3/4 inches in dimension and of proper moisture content for maximum consolidation.

B. Crushed granular material conforming to ASTM D448, Size No. 67.

C. Washed stone bedding size 1/4-inch to 3/4-inch.

2.03 COMMON FILL MATERIALS

A. Material shall not contain pieces larger than 3 inches, and shall be free of roots, debris, or organic matter.

2.04 SELECT FILL MATERIALS

A. Local regulatory agency Class 7, Class 3, and Class 4 as specified in this Section.

B. ASTM Soil Classification GC as set forth in ASTM Designation D2487-92. On site material may be used, provided it is in accordance with ASTM D2487-92.

2.05 BEDDING MATERIAL

A. Pea gravel, sand, or other locally available bedding material, as approved.

2.06 GRANULAR FILL MATERIAL

A. Granular Backfill:
   1. Natural or artificial mixture of gravel and soil mortar uniformly well graded from coarse to fine.
   2. Local regulatory agency Section 303 Class 3, Class 4, or Class 7 as specified in this Section.

2.07 COMPACTION EQUIPMENT

A. Suitable type and adequate to obtain the amount of compaction specified.

B. Operate in strict accordance with manufacturer's instructions and recommendations and maintain in such condition so that it will deliver manufacturer's rated compactive effort.

2.08 IMPORTED TOPSOIL

A. Suitable sandy loam from an approved source.

B. Must possess friability and a high degree of fertility.

C. Free of clods, roots, gravel, and other inert material.

D. Free of quackgrass, horsetail, and other noxious vegetation and seed.

PART 3 - EXECUTION

3.01 PREPARATION

A. Where clearing or partial clearing of right-of-way is necessary, complete prior to start of trenching.

B. Cut trees and brush as near to surface of ground as practicable, remove stumps, and pile for disposal.

C. Do not permit excavated materials to cover brush or trees prior to disposal.

3.02 PREVENT TRENCH WATER AND ANIMALS FROM ENTERING PIPE

A. When pipe laying is not in progress, including noon hours, open ends of pipe shall be closed; and no trench water, animals, or foreign material shall be permitted to enter the pipe.

3.03 DISPOSAL OF CLEARED MATERIAL

A. Dispose of material in such a manner to meet requirements of state, county, and local regulations regarding health, safety, and public welfare.

B. Dispose of nonflammable and flammable material off the construction site in an approved location.

C. Do not leave material on the Project site, shove onto abutting private properties, or bury in embankments or trenches.

3.04 REMOVAL OF OBSTRUCTIONS

A. Remove obstructions within trench area or adjacent thereto such as tree roots, stumps, abandoned piling, logs, and debris.

B. Engineer may, if requested, make changes in the trench alignment to avoid major obstructions, if such alignment changes can be made within the easement or right-of-way without adversely affecting the intended function of the facility.

C. Dispose of obstructions in accordance with this Section.

3.05 REMOVAL AND REPLACEMENT OF TOPSOIL

A. Where trenches cross lawns, garden areas, fields, or other areas on which reasonable topsoil conditions exist, remove topsoil for a depth of 6 inches for full width of trench to be excavated.

B. Use equipment capable of removing a uniform depth of material.

C. Stockpile removed topsoil at regular intervals, and do not mix with other excavated material.

D. Locate stockpiles so that material of one ownership is not transported and stockpiled on property of another ownership.

E. Minimum finished depth of topsoil over trenches: 5 inches.

F. Imported topsoil may be substituted for stockpiling and replacing topsoil.

G. Maintain finished grade of topsoil level with area adjacent to trench until final acceptance by Engineer.

H. Repair damage to adjacent topsoil caused by work operations.
   1. Remove rock, gravel, clay, and other foreign materials from the surface.
   2. Regrade.
   3. Add topsoil as required.

3.06 TRENCH WIDTH

A. Minimum width of unsheeted trenches where pipe is to be laid shall be 18 inches greater than the outside diameter of the pipe, or as approved.

B. Maximum width at top of trench will not be limited, except where excess width of excavation would cause damage to adjacent structures or property or cause undue stresses on the pipe.

C. Confine trench widths to dedicated rights-of-way or construction easements, unless special written agreements have been made with affected property owner.

3.07 EXCAVATION

A. Excavate trench to lines and grades shown or as established by Engineer with proper allowance for pipe thickness and for pipe base or special bedding when required.

B. If trench is excavated below required grade, correct with foundation stabilization material.

C. Place material over full width of trench in compacted layers not exceeding 6 inches deep to established grade with allowance for pipe base or special bedding.

3.08 PREPARATION OF TRENCH - LINE AND GRADE

A. Do not deviate more than ½ inch from line or ½ inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.

B. Grade the bottom of the trench by hand to the line and grade where the pipe is to be laid, with proper allowance for pipe thickness and for pipe base when specified or indicated.

C. Remove hard spots that would prevent a uniform thickness of bedding.

D. Check the grade with a straightedge and correct irregularities found.

E. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

3.09 SHORING, SHEETING, AND BRACING OF TRENCHES

A. Sheet and brace trench when necessary to prevent caving during excavation in unstable material or to protect adjacent structures, property, workers, and the public.

B. Increase trench widths accordingly by the thickness of the sheeting.

C. Maintain sheeting in place until pipe has been placed and backfilled at pipe zone.

D. Remove shoring and sheeting as backfilling is done in a manner that will not damage pipe or permit voids in backfill.

E. Conform to safety requirements of federal, state, or local public agency having jurisdiction for sheeting, shoring, and bracing of trenches; the most stringent of these requirements shall apply.

3.10 LOCATION OF EXCAVATED MATERIALS

A. Place excavated material only within construction easement, right-of-way, or approved working area.

B. Do not obstruct private or public traveled roadways or streets.

3.11 REMOVAL OF WATER

A. Provide and maintain ample means and devices to promptly remove and dispose of water entering trench during time trench is being prepared for pipe laying, during laying of pipe, and until backfill at pipe zone is completed.
   1. These provisions apply during the noon hour as well as overnight.
   2. Provide necessary means and devices, as approved, to positively prevent under water from entering the construction area of another contractor.

B. Dispose of water in a manner to prevent damage to adjacent property.

C. Drainage of trench water through the pipeline under construction is prohibited.

3.12 FOUNDATION STABILIZATION

A. When existing material in bottom of trench is unsuitable for supporting pipe, excavate unsuitable material.

B. Backfill trench to subgrade of pipe base with foundation stabilization material specified.

C. Place foundation stabilization material over the full width of trench and compact in layers not exceeding 6 inches deep to required grade by making passes with a vibratory compactor (or equivalent).

D. Material shall be considered unsuitable when it contains more than 5 percent organic material by volumetric sampling or when it will not support a reading of 1.5 on a hand penetrometer.

3.13 ROCK IN PIPE TRENCH

A. Where rock is encountered in bottom of trench, support pipe on bedding material.

B. Minimum Bedding Thickness: Minimum of 4 inches or one eighth of the outside diameter of pipe, whichever is greater.

C. Extend bedding up pipe sides one sixth of outside diameter of the pipe, minimum.

D. Backfill over pipe according to pipe zone type.

3.14 PIPE ZONE BACKFILL

A. Depth of the pipe zone above pipe barrel varies with pipe material.

B. Particular attention must be given to area of pipe zone from flow line to centerline of pipe to ensure firm support is obtained to prevent lateral movement of pipe during final backfilling of pipe zone.

C. Backfill area of pipe zone from bottom of pipe to horizontal centerline of pipe by hand-placing material around pipe in 4-inch layers.

D. Achieve continuous support beneath pipe haunches by "walking in" and slicing with shovel.

E. Backfill area of pipe zone from horizontal centerline to top of pipe zone with pipe zone material as determined by class of backfill.

F. In lieu of selected material for pipe zone in upper portion of pipe zone, imported pipe zone material approved by Engineer for trench backfill may be substituted.

G. If the Engineer determines that the existing material is insufficient or unsuitable at trench side for selected material for pipe zone in upper portion of pipe zone, provide suitable material from other trench excavation along pipeline or imported pipe zone material.

3.15 TRENCH BACKFILL ABOVE PIPE ZONE

A. When backfill is placed mechanically, push backfill material onto slope of backfill previously placed and allow to slide down into trench.

B. Do not push backfill into trench in such a way as to permit free fall of material until at least 2 feet of cover is provided over top of pipe.

C. Under no circumstances allow sharp, heavy pieces of material to drop directly onto pipe or tamped material around pipe.

D. Do not use backfill material of consolidated masses larger than ½ cubic foot.

3.16 EXCESS EXCAVATED MATERIAL

A. Dispose of excess excavated material off project site in an approved area.

3.17 DRAINAGE CULVERTS

A. Replace drainage culverts which are removed on near right angles to pipe centerline.

B. If pipe cannot be reused or is damaged during removal, dispose of it and provide new pipe.

C. Protect culverts from damage or restore to equivalent condition.

D. Replace culverts to existing lines and grades.

E. Do not replace culverts until proposed pipeline is installed and backfill of trench has been completed to subgrade of culvert.

3.18 PIPE COVER

A. Place select material from excavation over pipe to provide minimum coverage, as shown on Drawings or as directed by Engineer.

3.19 DRAINAGE DITCH RESTORATION

A. Undercrossings of minor drainage ditches not covered in another Specification Section shall be backfilled so that upper 1 foot of material in ditch between ditch banks is clay.

B. Compact material for full ditch width by 6 passes of vibratory compactor (or equivalent).

C. Where indicated on Drawings, provide concrete arch, and/or riprap on ditch banks.

3.20 SETTLEMENT

A. Correct settlement noted in backfill, fill, or in structures built over backfill or fill within warranty period.

3.21 IMPORTED TOPSOIL

A. Should regenerative material be present in soil, remove both surface and root which appears in within 1 year following acceptance of Project in a manner satisfactory to Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY OF WORK

A. Install slope protection and erosion and sediment control where erosion prevention is required.

PART 2 - PRODUCTS

2.01 RIPRAP

A. Hard and durable quarry stone with less than 35 percent wear when tested for resistance to abrasion in conformance with ASTM C535.

B. Bulk density shall not be less than 160 pounds per dry cubic foot.

C. The least dimension of any one piece shall not be less than 1/3 the greatest dimension. Smaller pieces will be allowed only to fill in the voids in the larger stone.

D. Unless otherwise specified, at least 60 percent of the material furnished shall weigh not less than 75 pounds each, with no dimension less than 4 inches and at least one dimension not less than 12 inches.

E. Riprap shall be placed to a minimum depth of 12 inches.

2.02 FILTER FABRIC

A. Nonwoven polypropylene or polyester fabric.

B. Manufacturer: Typar 3601, Mirafi Inc. 160N, or equal.

2.03 OVERLAND CONSTRUCTION

A. Sediment Barriers:
   1. In areas where natural vegetation is not present or where sufficient to attain the needed removal of silt, installation of sediment barriers shall be required.
   2. Use straw bale filters or silt fences. Install across or at the foot of slope or at outlet of a diversionary structure.
   3. Straw Bale Filter: Tightly bound straw bales embedded at least 4 inches into soil and each bale shall be held in place by 2 stakes driven at least 1-1/2 feet into ground. Bales shall tightly abut adjacent bales. Strings shall not be in contact with the ground.
   4. Silt Fence: Fence post spaced no more than 10 feet apart and driven a minimum of 2 feet into ground. Above-ground height of fence posts shall be no less than 2 feet. Fasten metal mesh fence with 6 inch or smaller openings to fence posts to reinforce the silt fence fabric. Mesh fence shall stand a least 2 feet above ground

and buried at least 4 inches below ground. Silt fence fabric that is reinforced may be used without a wire mesh support in low flow areas. In streams and in areas where high flow may be encountered, silt fence shall have a wire mesh to support the fabric.

5. Use temporary silt fences at base of road crossings to assist disturbed and undisturbed natural vegetation adjacent to pipeline right-of-way. Silt fencing can be either reinforced with wire mesh fencing in areas of potentially high flow surface run-off or where slope is steep enough to warrant a reinforced silt fence. On gentle slopes, reinforced with wire mesh and may be supplemented with hay or straw bales as a primary barrier to aid in collecting silt and potential sedimentation from entering ditch lines and waterways.

B. Diversion Ditches:

1. Diversion ditches shall act as a barrier to runoff water. Storm water flow shall be interrupted and diverted off the right-of-way.
2. Construct with earth-filled sacks or mounded compacted earth-filled sacks or mounded compacted earth and rock.
3. On long slopes, use a series of ditches.
4. Spacing depends on the severity of the slope. Maximum spacing for diversion ditches are given in Table 1. Distances may be shortened as situations dictate but should not be lengthened.
5. Drainage area above diversion ditches shall be stabilized to prevent excessive silt from entering and collecting in the diversion channel.
6. Runoff water shall be filtered at the outlet end of the ditch by a bale filter or silt fence.
7. Use ditch checks in conjunction with diversion ditches and filter structures to prevent surface runoff from circumventing an diversion ditches by flowing down the trench.
8. Spacing is related to the severity of right-of-way slopes. Maximum spacing for ditch checks given in Table 1.

TABLE 1

Spacing of Diversion Ditches and Ditch Checks	
Slope	Spacing
5 to 15%	150 Feet
15 to 30%	100 Feet
30 & or Greater	50 Feet

C. Ditch Checks:

1. Earth-filled sacks (or suitable alternative, synthetic foam).
2. Use ditch checks to form a catch basin for run-off in trench to prevent soil from being washed out of the trench.
3. Use in conjunction with diversion ditches and filter structures. Ditch checks shall prevent surface run-off from by-passing a diversion ditch by flowing down the trench. The use of ditch checks is site-specific, and may not be required.
4. Spacing related to the severity of right-of-way slopes. Guideline spacing for ditch checks are identical to the spacing requirements for diversion ditch.

D. Nonvegetative Soil Stabilization:
   1. Utilize temporary nonvegetative soil stabilization to provide protection against excessive soil erosion over a short-term period (less than one year).
   2. Nonvegetative methods shall be required in areas that experience high water flows and high runoff velocities (disturbed slopes steeper than 2:1).
   3. Methods employed include mulching, chemical soil stabilizers (binders), brush and slash, netting and matting, and store coverage.
   4. Mulch shall consist of straw, hay, or salt hay applied at an appropriate rate 70-115 pounds per 1000 square feet (1.5 to 2.5 tons/acre). Mulch anchoring shall be implemented promptly where applicable and achieved by one of the following methods:
      a. Peg and twine.
      b. Mulch netting.
      c. Erosion control.
      d. Fabric.
      e. Jute matting, as indicated on Drawings.
      f. Mulch anchoring tool.

E. Temporary Seeding and Revegetation:
   1. Soil that is stockpiled for more than 30 days or disturbed areas where there will be no construction for 12 months shall be stabilized to prevent erosion.
   2. If natural vegetation does not occur, area shall be temporarily seeded.
   3. Temporary revegetation of pipeline shall occur when new lines are established during the spring and summer period.
   4. New lines established in the fall and winter period shall require permanent revegetation.
   5. If required to temporary revegetate an area during the fall or winter period, a mixture of Austrian winter pea, rye, oats, and wheat shall be used.
   6. Provide a combination of milo, millets, and the Arkansas mix for temporary revegetation to control erosion. The use of a broadcast seeder after the last frost through July is acceptable.
   7. Alternative to Temporary Seeding: Mulching using the methods and rates give in this Section.

F. Stabilized Construction Entrance:
   1. Install at access points to construction site.
   2. Construct with large stone over geotextile fabric.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Riprap:
   1. Machine place riprap over filter fabric a minimum of 12 inches thick to limits shown on Drawings.
   2. Install riprap at locations where water is released from drainage system, to prevent scour.
   3. Place stone riprap on compacted subgrade.

B. Install sediment barriers, diversion ditches, and ditch checks in accordance with this Section and Drawings.

C. Trench Dewatering:
   1. Use ditch checks to control the collection of storm water in trenches. Water shall be allowed to sit in trench until silt settles out.
   2. If water must be removed immediately, water shall be filtered. Filtration shall be performed by natural vegetation, bale filters or silt filters.
   3. Use of a settling basin to allow silt to filter out shall be used when no other options are available. Refer to Drawings for use of settling basin.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Perform foundation and under floor termite control treatment in accordance with the Arkansas Pest Control Law and to qualify construction under this Contract for continuous guaranteed protection specified.
   1. Reference is made to Section IIIA - Minimum Requirements on Structural Pest Work on Existing Structures.

B. Applicable Regulations:
   1. International Building Code
   2. Arkansas Pest Control Law, A.C.A. 17-30-101 et. Seq. and Regulations
      a. Circular 6 revised December, 2013
      b. Arkansas State Plant Board
   3. Federal Insecticide, Fungicide and Rodenticide Act, (Public Law 92-516 of Oct. 21, 1972 as amended by Public Law 100-532, October 25, 1988).

1.02 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01 33 00.

B. Substitutions will not be considered prior to the award of the General Contract.

C. Submit a Termicide Application Plan, including Product Data, Design Data, Test Reports and Certificates.

1.04 GUARANTEE

A. Furnish damage guarantee with service and re-service for any subterranean termite infestation without cost to Owner. Write Damage Guaranty Contract additionally to cover any and all subterranean termite damage to the structures and contents in amount of $10,000. Such damage to be repaired, replaced or corrected at Contractor's expense.

B. Furnish damage guarantee effective for 5 year period after completion of initial treatment without payment of additional fees or premiums by Owner. Upon expiration of 5-year period, Owner has option of extending damage guarantee contract at an annual fee mutually agreed upon by Owner and applicator. Owner reserves the right to cancel as of any anniversary date. Service, re-service, and Damage Guaranty provisions of the extended damage contract are noncancellable by applicator. Annual fee subject to revision by giving advance written notice to Owner.

C. Include in the warranty annual inspections of the buildings, whether new or renovated, or building additions during the warranty period. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim:
   1. Re-treat the site and perform other treatment as may be necessary for elimination of subterranean termite infestation;
   2. Repair damage caused by termite infestation; and
   3. Reinspect the building approximately 180 days after the re-treatment.

1.05 ADMINISTRATIVE

A. Coordinate work related to final grades, landscape planting, foundations, or any other alterations to finished or renovated construction which might alter the condition of treated soils with this specification.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Chemical termite control uses liquid termiticide treatments applied to the soil, forming a continuous chemical barrier in the soil around both sides of the foundation. The application may be surface applied or rodded and trenched. This barrier prevents foraging termites from reaching the foundation and piers. Only the soil adjacent to these foundation elements is treated. For slab construction (including foundations, patios and garages), the entire soil (or gravel) surface shall be treated before the vapor barrier is installed and the slab poured over it. Soil treatment shall be coordinated with all building activities from foundation construction through final grading of the soil around the building's exterior. In order for the treatment to be effective, the final phase of the application must be done after final grading and, where required, after landscaping is completed so that treated soil is not disturbed.

2.02 TERMITE CONTROL CHEMICALS

A. Use chemicals approved by the Arkansas State Plant Board and of type required to give guaranteed protection specified.

PART 3 - EXECUTION

3.01 PREPARATION

A. From investigation at the site determine soil texture or otherwise obtain this information from the County Agent, Soil Conservation Service or other approved authorities, if not already known.

B. Eliminate food sources by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.02 TREATMENT

A. Perform foundation and under floor termite control treatment at buildings to be constructed and/or renovated under this Contract. Use type chemical approved by the Arkansas State Plant Board and currently known to give guaranteed protection for the soil and fill used at this Project. Apply chemical using applicator licensed by the Arkansas State Plant Board. Apply in sufficient quantity under and around the structures, to qualify building and contents for continuous guaranteed protection against damage by subterranean termites.

B. Reapply soil treatment solution to areas disturbed by subsequent excavation or construction activities following application.

C. **Under New Slabs:** Apply under slabs at the rate recommended by manufacturer. Apply after placement of gravel drainage fill and immediately prior to placement of vapor barrier. When necessary to insure proper penetration, the ground surface will be left loose or lightly scarified until treatment has been completed.

1. **Existing Slab Construction:** Treatments should be made when swarms occur or damage is found, or as a preventive measure.
    a. Treatment under the slab is accomplished by drilling holes in the slab or foundation through which chemical can be applied in accordance with label directions to establish a barrier in the soil. Long-rodding can sometimes be accomplished without drilling.
    b. Brick and stone veneer on slab construction is treated by drilling through the veneer and injecting the void between the veneer and the slab with chemical. Brick and stone veneer shall be treated with approved chemicals according to the label directions. If the label directions require drilling and treating and the maximum interval requirements are not specific, the intervals at which the operator drills to achieve adequate barriers shall be stated on the graph. In such cases if the maximum intervals are not stated on the graph the operator will be required to drill and treat at a maximum of 18 inch intervals.

D. Critical Areas: Treat a one foot strip along critical areas under walls, around interior piers and pipes rising from the ground at the rate recommended by manufacturer. Treatment shall be applied as specified for overall treatment under slabs.

E. Outside of Foundations: Apply a one foot strip along the outside of the foundations of the building at the rate recommended by manufacturer. Apply in a trench dug to a depth of approximately 2" below finish grade. Loosen earth in trench to a depth of 12" before treating. This treatment is to be performed prior to finish grading.

1. If the exterior perimeter treatment is applied when the horizontal barrier is applied it will be damaged or removed before construction is completed. The exterior foundation perimeter treatment will have to occur in phases when any pads, porches, aprons, sidewalks, final grading or landscape planting are simultaneously involved adjacent to the building foundation. This treatment area should be coordinated after all major construction but before any pads, porches, or other items requiring special consideration are poured adjacent to the foundation walls. Submit written verification that final grading, landscape planting and other items adjacent to the foundation will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.03 UTILITIES AND VENTS

A. Turn off and block HVAC ducts and vents located in treatment area prior to application, to protect people and animals from termiticide. Submit written verification that the HVAC ducts and vents, water and sewer lines, and plumbing have been turned off or blocked prior to applying termiticide.

3.04 CRAWL AND PLENUM AIR SPACES

A. Submit written verification that crawl and plenum air spaces have been located and identified prior to applying termiticide.

3.05 APPLICATION PLAN

A. Prior to commencing application of termiticide, submit a Termiticide Application Plan addressing the following items:

a. proposed sequence of treatment work including dates and times of application
b. termiticide trade name
c. EPA registration number
d. chemical composition
e. concentration of original and diluted material
f. formulation
g. manufacturer's recommended application rates
h. regional requirements
i. application rate of active ingredients
j. method of application
k. area or volume to be treated
l. amount to be applied

m. copy of the pest control business license
n. copy of the pesticide applicator certificates

3.06 APPLICATION

A. For areas to be treated, establish complete and unbroken vertical and horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Make applications to crawl spaces in accordance with label directions. Applications to crawl space areas that are used as plenum air spaces will not be permitted.

3.07 EQUIPMENT CALIBRATION AND TANK MEASUREMENT

A. Submit a list of equipment to be used. Conduct calibration test on the application equipment to be used immediately prior to commencement of termiticide application. Measure the volume and contents of the application tank. Testing must confirm that the application equipment is operating within the manufacturer's specifications and meets the specified requirements. Submit written certification of the equipment calibration test results within 1 week of testing. Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.08 FIELD QUALITY CONTROL

A. Verification of Measurement
   1. Once termiticide application has been completed, measure tank contents to determine the remaining volume. The total volume measurement of used contents for the application must equal the application rate established in the application plan. Submit written verification that the volume of termiticide used meets the application rate established in the application plan.

B. Inspection
   1. Technical Representative: Provide a technical representative who is a certified pesticide applicator. The technical representative must be present at all meetings concerning treatment measures for subterranean termites and during treatment application.

3.09 CLOSEOUT ACTIVITIES

A. Upon completion of this work, submit the Pest Management Report, or an equivalent computer product, to the contractor. This form shall identify the target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

3.10 PROTECTION OF TREATED AREA

A. Immediately after the application, protect the area from other use by erecting barricades as required or directed, including signage. Place signage inside the entrances to crawl spaces and identify the space as treated with termiticide and not safe for children or animals. Cover treated areas with plastic if slab is not to be poured immediately following termiticide application.

B. Disturbance of Treated Soils
   1. Re-treat soil and fill material disturbed after treatment before placement of slabs or other covering structures.

END OF SECTION 31 31 16

PART 1 - GENERAL

1.01 SUMMARY

A. This item shall consist of a foundation course for surface course, for other base courses, or for pavements.

B. It shall be constructed on the prepared subgrade, subbase, or other completed base course according to these specifications and in substantial conformity with the lines, grades, compacted thickness, and typical cross section shown on the plans.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate Base Course shall be either gravel and/or crushed stone so proportioned as to meet the requirements for a class of aggregate specified in the following table:

Sieve,mm	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8
				PERCENT PASSING				
75 (3")	100	100	100					
50 (2")	95-100	95-100	95-100					
37.5 (1-1/2")				85-100	100	100	100	
25.0 (1")								100
19.0 (3/4")	60-100	60-100	60-100	60-100	60-100	50-90	50-90	65-100
9.5 (3/8")	40-8-	40-80	40-80	40-80	40-80			
4.75 (#4)	30-60	30-60	20-60	30-60	30-60	25-55	25-55	25-55
2.0 (#10)	20-50	20-50	20-45	20-45	20-45			
0.425 (#40)	10-35	10-35	10-35	10-35	10-35	10-30	10-30	10-30
0.075 (#200)	3-15	3-15	3-12	3-12	3-12	3-10	3-10	3-10
MAX. PLASTICITY INDEX (MINUS								
0.425 MATL.)	13	10	6	6	6	6	6	6
(#40) MINIMUM PERCENT CRUSHED (RETAINED ON 4.75 mm [#4] SIEVE					15			
MINIMUM PERCENT CRUSHER-RUN MATERIAL						90	90	90

B. Class 7 and 8 shall be any mechanically crushed natural rock or stone of igneous, sedimentary, and/or metamorphic origin produced from a solid geological formation by quarrying method.

C. The Contractor shall have the option of using any higher numbered class Aggregate Base Course than that specified, provided that payment will be for the class specified.

D. Material furnished for Aggregate Base Course, Class 3 through Class 8, shall have a percent of wear by the Los Angeles Test not greater than 45 as determined by AASHTO T 96.

E. When it is necessary to blend two or more materials, each material shall be proportioned separately through mechanical feeders to ensure uniform production. Premixing or blending to avoid separate feedings will not be permitted. Production of material by blending materials on the roadway to obtain a mixture that will comply with the requirements specified herein will not be permitted.

F. For the purpose of this specification, shale and slate are not considered to be gravel or stone. The material furnished shall not obtain more than 5percent by weight of shale, slate, and other objectionable, deleterious, or injurious matter.

G. For Class 1 and 2 materials, the fraction passing the 0.075 mm (#200) sieve shall not be greater than three-fourths of the fraction passing the 0.425 (#40) sieve. For Classes 3 through 8, the fraction passing the 0.075 mm (#200) sieve shall not be greater than two-thirds of the fraction passing the 0.425 mm (#40) sieve. For Classes 3 through 8 the fraction passing the 0.425 mm (#40) sieve shall have a liquid limit not greater than 25.

H. To ensure that gravel is uniformly graded, the difference between the percent passing the various sieves shall be as follows for Classes 3, 4 and 5:

Sieve		Percent
19.0 mm - 9.5 mm	(3/4" - 3/8")	5 min.
9.5 mm - 4.75 mm	(3/8" - #4)	5 min.
4.75 mm - 2.00 mm	(#4 - #10)	5 min.
2.0 mm - 0.425 mm	(#10 - #40)	4 min.

I. When the material contains aggregate larger than that specified above for the class called for in the Contract, the oversize aggregate shall be removed by screening or by screening and crushing. The removal of large size aggregate by hand methods will not be permitted.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. The base course material shall be placed on a completed and approved subgrade or existing base that has been bladed to substantially conform to the grade and cross section shown on the plans.

B. The subgrade shall be prepared as specified in Section 31 00 00 - Earthwork, and shall be free from an excess or deficiency of moisture at the time of placing base course material.
   1. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the Contract that provide for the construction, reconstruction, or shaping of the subgrade or the reconstruction of the existing base course.

C. Base course material shall not be placed on a frozen subgrade or subbase.

D. The aggregate shall be placed on the subgrade or other base course material and spread uniformly to such depth and lines that when compacted it will have the thickness, width, and cross section shown on the Drawings.

E. If the required compacted depth of the base course exceeds 150 mm (6 inches), the base shall be constructed in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 150 mm (6 inches) except when vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of base course may be increased to 200 mm (8 inches) upon approval of the Engineer.

F. The material shall be spread the same day that it is hauled. Spreading shall be performed in such a manner that no segregation of course and fine particles nor nests or hard areas caused by dumping the aggregate on the subgrade will exist. Care shall be taken to prevent mixing of subgrade or unspecified material with the base course material during the blading and spreading operation.

G. Aggregate shall not be dumped or mixed on an existing or newly constructed ACHM course or PCC Pavement that will not be overlaid under the same Contract nor on any open graded base course. Mechanical spreading equipment shall be used, if necessary, to place the base course on the subgrade.

H. If sufficient working space is not available to allow proper aeration or addition of water to the base, the base material shall be mixed by any satisfactory method before placement.

I. Each course shall be thoroughly mixed for the full depth of the course and shall be compacted by any satisfactory method that will produce the density thereinafter specified.
   1. The aggregate shall be maintained substantially at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as may be necessary.
   2. The specified grade and cross section shall be maintained by blading throughout the compaction operation.
   3. The material in each course shall be compacted to a density, as determined by AASHTO T 238, Method B, of not less than 98 percent of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D.
   4. The aggregate shall be compacted across the full width of application.

J. The compacted base course shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and recompacting to the specified density, as directed.

K. Where neither prime coat nor surfacing is provided in the same Contract with the base course, the material in the base course shall be uniformly compacted, stable, and free of segregated areas.

L. The Contractor shall maintain the base course in a satisfactory condition until accepted.

3.02 QUALITY CONTROL

A. To assure that the material used meets the requirements of the specifications, certain tests for quality control and acceptance will be performed as specified herein. The properties for which quality control and acceptance testing will be performed are gradation, density, moisture content, plasticity index, and thickness as specified in each Section.

B. The maximum laboratory density shall be determined as follows:

% Retained - 4.75 mm (#4) Sieve	Test Method
10 Max.	AASHTO T 99, Method A
11 - 30	AASHTO T 99, Method C
31 Min.	AASHTO T 180, Method D

Note: In lieu of AASHTO T224, correction for coarse particles retained on the 3/4" (19.0 mm) sieve shall be determined by replacing with an equal mass of material passing the 3/4" (19.0 mm) sieve and retained on the #4 (4.75 mm) sieve.

C. The in-place density shall be determined by using AASHTO T 310, Direct Transmission. The moisture content shall be determined by AASHTO T 310. A new maximum laboratory density and optimum moisture will be determined whenever the Engineer deems necessary or upon evidence provided by the Contractor.

D. Tests for gradation, liquid limit, and plasticity index shall be performed by AASHTO T 11, T 27, T 89, and T 90.

E. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing.

F. The Contractor shall provide the Engineer with the opportunity to observe all quality control sampling and testing.

G. All quality control sampling and testing shall be performed by or under the direct supervision of a technician acceptable to the Owner. Test reports shall be signed and copies made available to the Engineer if requested.

H. If the results of any test shows that the required minimum density has not been obtained, corrective action shall be taken, followed by a re-test at the same location. The original and re-test reports shall be cross referenced. All corrective actions shall be performed by the Contractor at no cost to the Owner.

3.03 ACCEPTANCE

A. Acceptance testing for thickness (when specified on the Drawings), gradation, plasticity index, density, and moisture content will be based on lots. The size of standard lots will be 100 cubic yards. Partial lots, of any size, may be established by the Engineer at any time.

B. Test methods for acceptance shall be the same as specified for quality control testing.

C. The item of work being tested shall not be considered complete or accepted until passing test reports are submitted to the Engineer.

D. The Contractor shall take one test for all properties in each lot or partial lot at a location randomly selected by the Engineer.

E. In addition to the required acceptance tests, the Engineer may require the Contractor to test any location that, by visual observation, appears to be defective.

F. The Contractor's acceptance sampling and testing procedures and results will be subject to independent assurance sampling and testing conducted by the Owner. The Contractor shall be required to make changes to the equipment and/or procedures if the such tests are unable to verify the Contractor's test results.

G. All acceptance testing performed by the Contractor is subject to observation by the Engineer. All test reports shall be signed and submitted to the Engineer the next business day after the tests are performed.

H. If a lot or a partial lot fails to meet the specifications, the Contractor shall remove and replace that lot or partial lot with acceptable material at no cost to the Owner. Tests will be performed on the replacement material as required for the original material. Acceptance of the replacement material will be the same as for the original material.

I. Payment for the quantity in the original lot will be withheld or recovered, and released after the removal and replacement has been acceptably performed.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Prepare asphaltic concrete pavement in accordance with this Section and where indicated on the Drawings.

B. Contractor will pay cost of testing.

C. Construct Work of this Section that is adjacent to or connected to city streets in accordance with requirements of the City for city streets.

D. Secure permits and inspections, post necessary bonds, and pay necessary fees.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, North West, Suite 225, Washington, DC 20001.
   1. AASHTO M14 - Anionic Emulsified Asphalt.
   2. AASHTO M81 - Cut-Back Asphalt Concrete (Rapid-Curing Type).
   3. AASHTO M82 - Cut-Back Asphalt Concrete (Medium-Curing Type).
   4. AASHTO M208 - Cationic Emulsified Asphalt.

B. American Society of Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
   2. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. (2.49-kg) Rammer and 12-in. (304.8-mm) Drop.
   3. ASTM D946 - Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
   4. ASTM D977 - Specification for Emulsified Asphalt.

C. Arkansas Department of Transportation, P.O. Box 2262, Little Rock, Arkansas 72203.
   1. ARDOT - Standard Specifications, Division 400, Latest Edition.

PART 2 - PRODUCTS

2.01 ASPHALTIC PAVING MATERIALS

A. Prime Coat: Medium curing cut-back asphalt; MC-30 or MC070; AASHTO M82; heated and applied within the temperature range 80 degrees F. - 150 degrees F.

B. Tack Coat:
   1. Rapid curing cut-back asphalt:
      a. AASHTO M81

b. SS-1
c. Application temperature 70 degrees F. - 160 degrees F.
d. Rapid curing emulsified asphalt to match aggregate type.
e. Cationic: CRS-1; AASHTO M208
f. Application temperature 125 degrees F. - 185 degrees F.

C. Hot-mix surfacing material shall meet the following requirements:
1. Asphaltic Cement: Mix Design in accordance with Arkansas State Highway and Transportation Department, latest edition.
2. Testing: Tests of asphalt mixtures and materials will be made by commercial testing laboratory approved by Owner. Submit test reports to Engineer.
3. Owner shall pay for all passing tests. Contractor shall be responsible for the cost of testing all material which fails to meet the requirements.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. Subgrade for asphalt paving improvements shall have organic silty and clayey topsoils and other unsuitable material removed and replaced with approved material.

B. Fill and tamp traces of utility trenches.

C. Scarify and re-compact subgrade; proof roll with dump truck.

D. Replace soft spots as needed.

3.02 BASE COURSE FOR ASPHALTIC PAVING

A. Place material on prepared subgrade for a total compacted thickness, as required on plans.
1. Spread course the same day the material is hauled. It shall be thoroughly mixed, either by repeated handling with a blade grader or by harrowing sufficiently to secure a uniform mixture or course and fine particles.
2. Compact base course by systematically rolling and watering as required to obtain a firm, uniform, smooth surface as specified in Part 300 of ARDOT Standard Specifications for Highway Construction.
3. Set blue tops prior to final finishing of base course.

B. Minimum density shall be 100 Percent Modified Proctor (ASTM D-1557).

C. Prime coat shall not be put down until base course is compacted.

3.03 PRIME COAT

A. After acceptance of completed base course, a prime coat shall be uniformly distributed over the prepared base at the rate of 0.3 gallon per square yard.

B. Remove surplus asphalt material.

C. Construct and maintain barricades to keep traffic off the primed surface until it is thoroughly cured and ready for asphalt pavement (3 days minimum).

3.04 TACK COAT

A. Apply tack coat when an asphalt course is to be laid on an asphalt or concrete surface.

B. Clean surface to be treated with prime or tack.
   1. Sweep with mechanical broom immediately preceding the application of prime or tack.
   2. Remove patches of asphalt, dirt or other material which does not form an integral part of the surface.
   3. When directed, sprinkle the surface with water and give an additional sweeping.

3.05 HOT-MIX SURFACING FOR ASPHALTIC PAVING

A. Plant Mixing and Transporting: Mixing, transportation, and temperature limitations for hot-mix surface course materials shall be in accordance with the requirements of Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, latest Edition.

B. Placing, compacting, and acceptance shall be in accordance with Division 400, Asphalt Pavements of the ARDOT Standard Specifications for Highway Construction, latest Edition.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Construction of concrete curbs, gutters, sidewalks, and streets.

1.02 RELATED SECTIONS

A. Section 03 15 16 - Expansion, Construction, and Contraction Joints.

B. Section 03 20 00 - Concrete Reinforcing.

C. Section 03 30 00 - Cast-in-Place Concrete.

D. Section 31 00 00 - Earthwork.

E. Section 31 10 00 - Site Clearing.

F. Section 31 23 33 - Trenching and Backfilling.

1.03 REFERENCES

A. American Concrete Institute, 22400 W. Seven Mile Road, Detroit, Michigan 48219.
   1. ACI 614.

B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM C94 - Specification for Ready-Mixed Concrete.
   2. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   3. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
   4. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

1.04 SUBMITTALS

A. Submit complete information regarding concrete mix to Engineer for review in accordance with the requirements of ASTM C94, Alternate 2.

PART 2 - PRODUCTS

2.01 CURB FORMS

A. 2-inch dressed dimension lumber or metal of equal strength, free from defects that would impair appearance or structural quality of completed curb.
   1. Metal forms: Subject to approval of Engineer.

B. Short-Radius Forms: 1-inch dressed lumber or plywood.

C. Curb Face: No horizontal joints in form material closer than 7 inches from top of curb.

D. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

2.02 SIDEWALK FORMS

A. 2-inch dressed lumber, straight and free from defects, or standard metal forms.

B. Short-Radius Forms: 1-inch dressed lumber or plywood.

C. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

2.03 CRUSHED ROCK BASE

A. Clean gravel or crushed rock conforming to requirements for granular fill as specified in Section 31 23 33.

2.04 EXPANSION JOINT FILLER

A. 1/2-inch thick preformed asphalt-impregnated expansion joint material conforming to ASTM D994.

2.05 CONCRETE

A. Ready mixed conforming to ASTM C94, Alternate 2.

B. Compressive Strength: 3,000 psi at 28 days.

C. Maximum Strength of Aggregate: 1-1/2-inch.

D. Slump: 2 to 4 inches.

2.06 CURING COMPOUND

A. Liquid membrane-forming, clear or translucent, suitable for spray application.

B. Conform to ASTM C309, Type 1.

2.07 ACCEPTANCE OF MATERIALS

A. Materials shall be subject to inspection for suitability by the Engineer prior to or during incorporation into the work.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Excavate and backfill in accordance with Section 31 23 33.

3.02 PREPARATION OF SUBGRADE

A. Bring the areas where curbs and sidewalks are to be constructed to required grade on undisturbed ground and compact by sprinkling and rolling or mechanical tamping.

B. As depressions occur, refill with suitable material and recompact until the surface is at the proper grade.

C. Compact subgrade on fill to 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

3.03 PLACING CRUSHED ROCK BASE

A. After subgrade for sidewalks and curbs is compacted and at proper grade, spread at least 4 inches granular fill and compact to at least 95 percent of maximum density as determined by ASTM D698.

B. Sprinkle with water and compact by rolling or other method.

C. Top of compact granular fill shall be at proper level to receive concrete.

3.04 SETTING FORMS

A. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings.

B. Stake wood or metal forms securely in place, true to line and grade.

C. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.

D. Construct short-radius curved forms to exact radius.

E. Tops of forms shall not depart from grade line more than 1/8 inch when checked with a 10 foot straightedge.

F. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

G. Forms shall be cleaned and oiled thoroughly after each use and before concrete is placed.

3.05 CURB CONSTRUCTION

A. Construct curbs to line and grade shown or established by the Engineer, and conform to the details shown on Drawings.

B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Wherever requirements differ, the more stringent shall govern.

C. Cast in uniform lengths of approximately 10 to 20 feet, except at closures where lengths may not be less than 6 feet.

D. Placement of Preformed Asphalt-Impregnated Expansion Joints:
   1. At intervals not exceeding 40 feet.
   2. Beginning and end of curved portions of the curb.
   3. Connections to existing curbs.

E. Contraction Joints:
   1. Place at intervals not exceeding 10 feet.
   2. Open type joint.
   3. Provide by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.
   4. Steel sheet shall be inserted the full depth of the curb.
   5. After initial set has occurred in the concrete and prior to removing the front curb form, steel sheet shall be removed with a sawing motion.

F. As soon as concrete has set sufficiently to support its own weight, remove the front form and finish all exposed surfaces.
   1. Finish top of curb with a steel trowel.
   2. Finish edges with a steel edging tool.
   3. Rub formed faces with burlap sack or similar device to produce a uniformly textured surface, free from form marks, honeycomb, and other defects.

G. Curing:
   1. Upon completion of finishing, apply approved curing compound to exposed surfaces of curb.
   2. Curing shall continue for a minimum of 5 days.

H. Backfilling Curb: Upon completion of curing period, but not before 7 days has elapsed since pouring the concrete, backfill the curb as specified in Section 31 23 33.

I. Adjusting:
   1. Finished curb shall present a uniform appearance for both grade and alignment
   2. Remove curb sections showing abrupt changes in alignment or grade or that are more than 1/4 inch away from location as staked or that are defective for any reason.
   3. Construct new curb at Contractor's expense.

3.06 SIDEWALK CONSTRUCTION

A. Thickness of sidewalks shall a minimum of 4 inches or as shown on the Drawings, with a turned down edge. Concrete shall be placed true to grade to ensure that ponding of water will not occur.

B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Where the requirements differ, the more stringent shall govern.

C. Placement of Preformed Asphalt Expansion Joints:
   1. Where sidewalk ends.
   2. Around posts, poles, or other objects protruding through the sidewalk.
   3. At maximum intervals of 15 feet.

D. Contraction Joints:
   1. Provide transversely to the walks.
   2. Saw cut weakened plane joints shall be straight and at right angles to the surface of the walk. Saw cuts shall be constructed midway between expansion joints to a depth of 25 percent of slab thickness. Saw cuts shall be performed within 24 hours of placement.

E. Reinforcing: 6 by 6 inch, No. 10 mesh shall be installed.

F. Finish:
   1. Broom surface with fine hair broom at right angles to length of walk and tool at edges, joints, and markings.
   2. Walks shall be scored at no less than 5-foot intervals and within 24 hours of concrete placement.

G. Curing:
   1. Upon completion of finishing, apply an approved curing compound to exposed surfaces.
   2. Protect sidewalks from damage for period of 7 days.

3.07 CONCRETE STREET PAVING

A. In areas shown to receive concrete paving on the Drawings, concrete shall be placed in accordance with Division 3 (Site Concrete Work).

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Expansion and contraction joints within portland cement concrete surfaces.
   2. Joints between cement concrete and asphalt pavement.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

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.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

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 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.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 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.
2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range between the color black and dark grey.

C. Finish of Joint: Sand joint filler.

2.03 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
   1. Available products:
      a. Crafco Inc.; RoadSaver Silicone.
      b. Dow Corning Corporation; 888.

2.04 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.05 PRIMERS

A. Primers: Product 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.

PART 3 - EXECUTION

3.01 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.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or 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.

3.03 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. Install backer materials 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 backer materials.
   2. Do not stretch, twist, puncture, or tear backer materials.
   3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. 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 provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealants from surfaces adjacent to joint.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 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 and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Construction of concrete curbs and sidewalks.

1.02 RELATED SECTIONS

A. Section 31 00 00 - Earthwork

1.03 REFERENCES

A. American Concrete Institute, 22400 W. Seven Mile Road, Detroit, Michigan 48219.
   1. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM C94 - Specification for Ready-Mixed Concrete.
   2. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   3. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
   4. ASTM D994 - Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

1.04 SUBMITTALS

A. Submit complete information regarding concrete mix to Engineer for review in accordance with the requirements of ASTM C94, Alternate 2.

PART 2 - PRODUCTS

2.01 CURB FORMS

A. 2-inch dressed dimension lumber or metal of equal strength, free from defects that would impair appearance or structural quality of completed curb.
   1. Metal forms: Subject to approval of Engineer.

B. Short-Radius Forms: 1-inch dressed lumber, plywood, or metal.

C. Curb Face: No horizontal joints in form material closer than 7 inches from top of curb.

D. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

2.02 SIDEWALK FORMS

A. 2-inch dressed lumber, straight and free from defects, or standard metal forms.

B. Short-Radius Forms: 1-inch dressed lumber or plywood.

C. Stakes and Bracing Materials: Provide as required to hold forms securely in place.

2.03 CRUSHED ROCK BASE

A. Clean gravel or crushed rock conforming to requirements for granular fill as specified in Section 31 23 33.

2.04 EXPANSION JOINT FILLER

A. 1/2-inch thick preformed asphalt-impregnated expansion joint material conforming to ASTM D994.

2.05 CONCRETE

A. Ready mixed conforming to ASTM C94, Alternate 2.

B. Compressive Strength: 3,000 psi at 28 days unless noted otherwise on Drawings.

C. Maximum Size of Aggregate: 1-1/2-inch.

D. Slump: 2 to 4 inches.

2.06 CURING COMPOUND

A. Liquid membrane-forming, clear or translucent, suitable for spray application.

B. Conform to ASTM C309, Type 1.

2.07 ACCEPTANCE OF MATERIALS

A. All materials shall be subject to inspection for suitability, as the Engineer may elect, prior to or during incorporation into the work.

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Excavate and backfill in accordance with Section 31 23 33.

3.02 PREPARATION OF SUBGRADE

A. Bring the areas on which curbs and sidewalks are to be constructed to required grade on undisturbed ground and compact by sprinkling and rolling or mechanical tamping.

B. As depressions occur, refill with suitable material and recompact until the surface is at the proper grade.

C. Compact subgrade on fill to 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

3.03 SETTING FORMS

A. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings.

B. Stake wood or metal forms securely in place, true to line and grade.

C. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.

D. Construct short-radius curved forms to exact radius.

E. Tops of forms shall not depart from grade line more than 1/8 inch when checked with a 10-foot straightedge.

F. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

3.04 CURB CONSTRUCTION

A. Construct curbs to line and grade shown or established by the Engineer, and conform to the details shown.

B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Wherever requirements differ, the more stringent shall govern.

C. Placement of Preformed Asphalt-Impregnated Expansion Joints (1/2 inch thick):
   1. Beginning and end of curved portions of the curb.
   2. Connections to existing curbs.
   3. At drainage structures.

D. Contraction Joints: All contraction joints shall be formed by sawing unless otherwise specified, and filled with a commercially available silicone product approved by the Engineer.
   1. Contraction joints shall be constructed at 15 foot intervals.
   2. Contraction joints shall be 1/8 inch to 3/8 inch in width and 1-1/2 inch in depth.
   3. Contraction joints shall be constructed at right angles to the centerline and perpendicular to the surface of the curb and gutter.
   4. When curb and gutter is constructed adjacent to, or on rigid pavement, the same joint layout for pavement shall be used, where practicable.

E. As soon as concrete has set sufficiently to support its own weight, remove the front form and finish all exposed surfaces.
   1. Finish top of curb with a steel trowel.
   2. Finish edges with a steel edging tool.

3. Rub formed faces with burlap sack or similar device to produce a uniformly textured surface, free from form marks, honeycomb, and other defects.

F. Fill contraction joints with a commercially available silicone product approved by the Engineer.

G. Curing:
1. Upon completion of finishing, apply approved curing compound to exposed surfaces of curb.
2. Curing shall continue for a minimum of 5 days.

H. Backfilling Curb: Upon completion of curing period, but not before 7 days has elapsed since pouring the concrete, backfill the curb as specified in Section 31 23 33.

I. Adjusting:
1. Finished curb shall present a uniform appearance for both grade and alignment.
2. Remove curb sections showing abrupt changes in alignment or grade or which are more than 1/4 inch away from location as staked or which are defective for any reason.
3. Construct new curb at Contractor's expense.

3.05 SIDEWALK CONSTRUCTION

A. Thickness of sidewalks shall be as shown on the Drawings.

B. Place, process, finish, and cure concrete in conformance with this Section and the applicable requirements of ACI 614. Where the requirements differ, the more stringent shall govern.

C. Placement of Preformed Asphalt Expansion Joints (1/2 inch thick):
1. Where sidewalk ends.
2. Around posts, poles, or other objects protruding through the sidewalk.
3. Drainage structures.
4. Adjacent to curb and gutter

D. Transverse Joints:
1. Joints shall be cut with a 1/4 inch joint at intervals not greater than the width of the walk being constructed, or as directed.

E. Finish:
1. Broom surface with fine hair broom at right angles to length of walk and tool at all edges, joints, and markings.
2. Edges shall be rounded in a 1/4 inch radius, including edges at joints.

F. Curing:
1. Upon completion of finishing, apply an approved curing compound to exposed surfaces.
2. Protection sidewalk from damage for period of 7 days.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts and center drop for gates.
4. Manual gates and related hardware.
5. Privacy slats.

1.3 REFERENCES

A. ASTM International:
1. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
6. ASTM A817 - Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire.
7. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
8. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
9. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
10. ASTM F552 - Standard Terminology relating to Chain Link Fencing.
11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
12. ASTM F626 - Standard Specification for Fence Fittings.
13. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
14. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
15. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.

16. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
17. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
18. ASTM F1183 - Standard Specification for Aluminum Alloy Chain Link Fence Fabric.
19. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
20. ASTM F1345 - Standard Specification for Zinc - 5% Aluminum -Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.

B. Chain Link Fence Manufacturers Institute:
1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Fence Height: New fences are to follow the height indicated on the Drawings.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Fence Post and Rail Strength: Conform to ASTM F1043 Light Industrial Fence quality.

1.5 SUBMITTALS

A. Section 01 33 00 “Submittal Procedures”: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings, and hardware.

D. Samples: Submit two 24- x 12-inch samples of fence fabric, inch in size illustrating construction and colored finish.

E. Manufacturer's Installation Instructions: Submit installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

B. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

A. Supply material according to CLFMI - Product Manual.

B. Perform installation according to ASTM F567.

C. Maintain 1 copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum 3 years' documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

B. Identify each package with manufacturer's name.

C. Store fence fabric and accessories in secure and dry place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For all materials, match materials as indicated on the Drawings.

B. Framing (Steel): ASTM A1011/A1011M; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum Grade 50; coating conforming to ASTM F1043 Type B on pipe exterior and interior.

C. Fabric Wire (Steel): ASTM A392 Class 1 zinc-coated steel wire.

D. Concrete: Type specified in Section 32 13 13.

2.2 COMPONENTS

A. Line Posts: 1.9-inch diameter.

B. Corner and Terminal Posts: 3.5 inches.

C. Gate Posts: 3.5-inch diameter.

D. Top and Brace Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66-inch diameter for welded fabrication.

F. Fabric: 2-inch diamond mesh interwoven wire, 9-gage thick, top salvage twisted tight, bottom selvage knuckle end closed.

G. Tension Wire: 6-gage-thick steel, single strand, marcelled, spiraled or crimped, aluminum-coated tension wire conforming to ASTM A824.

H. Tension Band: 7-gage-thick steel.

I. Tension Strap: 1/4- x 3/4-inch-thick steel.

J. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Aluminum alloy; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Cast steel galvanized, match existing perimeter fence at Little Rock Zoo.

D. Gate Hardware: Center gate stop and drop rod; lockable latch; three 180-degree gate hinges for each leaf. Match existing “Gate 4” at Little Rock Zoo.

2.4 GATES

A. Match existing “Gate 4” at Little Rock Zoo.

B. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.

C. Factory assemble gates.

D. Design gates for operation by 1 person.

2.5 PRIVACY SLATS

A. For perimeter fence only. Match existing privacy material of perimeter fence at Little Rock Zoo.

2.6 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 oz/sq. ft. coating.

B. Hardware: Galvanized to ASTM A153/A153M, 1.8 oz/sq. ft. coating.

C. Accessories: Same finish as framing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates according to ASTM F567.

B. Set intermediate, terminal, and gate, posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Line Post Footing Depth Below Finish Grade: 3 feet, minimum, as indicated on the Drawings.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3 feet, minimum, as indicated on the Drawings.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail 1 bay from end and gate posts.

F. Install top rail through line post tops and splice with 6 long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 2 inches above finished grade.

L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 24 inches on centers.

M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

N. Install bottom tension wire stretched taut between terminal posts.

O. Support gates from gate posts. Do not attach hinged side of gate from building wall.

P. Install gate with fabric and barbed wire overhang to match fence. Install 3 hinges on each gate leaf, latch, catches, drop bolt.

Q. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

R. Connect to existing fence at new terminal post.

S. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.

T. Excavate holes for posts to 12-inch diameter and 10 foot maximum spacing without disturbing underlying materials.

U. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

V. Extend concrete footings 1 inch above grade, and trowel, forming crown to shed water.

W. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 PRIVACY SLATS

A. Fasten slats according to manufacturer's instructions.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4-inch.

B. Maximum Offset from Indicated Position: 1 inch.

C. Minimum Distance from Property Line: 6 inches.

END OF SECTION 32 31 13

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Gates and gate hardware.

C. Clearing.

1.02 REFERENCES

A. Specification of Metallic-Coated Steel Chain Link Fence Fabric, published by Chain Link Fence Manufacturers Institute, Washington, DC 20036.

B. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM A239 - Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip).
   2. ASTM F567 - Practice for Installation for Chain-Link Fence.

PART 2 - MATERIALS

2.01 FABRIC (EXCEPT BACKSTOP NETTING)

A. Height: 6 feet, 8 feet, 12 feet or as noted on plans.

B. Composed of individual wire pickets helically wound and interwoven from No. 9 or No. 6 gage steel wire (coated in black colored vinyl), as shown on drawings, to form a continuous chain link fabric having a 2-inch diamond mesh pattern.

C. Top and bottom of fence fabric shall be Knuckle x Knuckle.

D. Hot-dip galvanized after weaving.

E. Black vinyl coating of not less than 1.2 ounces per square foot of bare wire surface.

2.02 LINE POSTS

A. 2-3/8-inch outside diameter standard steel pipe weight 3.65 pounds per linear foot or approved equal.

2.03 END, CORNER, ANGLE, AND PULL POSTS

A. Use 2-7/8-inch outside diameter steel pipe weighing 5.79 pounds per linear foot or approved equal.

2.04 PRIVACY FENCE SLATS

A. Manufacturer: PrivacyLink®, PO Box 295, Hyde Park, Utah 84318, 1-888-806-7528 or approved equal. www.eprivacylink.com **Color:** Forest Green. **Limited Warranty:** 25 years pro-rata.

1. **Winged Slats®** - Self-locking slats (no locking channels are needed) combine the proven quality and durability of standard slats with unique "wings" for extra screening and security. This uniquely styled, patented slat can be purchased by the bag or pre-inserted into the chain link wire during the weaving process.
2. **Installation:** Insert the slats vertically into the fence from top to bottom. No tools are necessary. The serrated wings grip the knuckles of the wire mesh securing the slat in place.
3. **Standard Chain Link Fence Heights:** 4 ft., 5 ft., 6 ft., 7 ft., and 8 ft. For heights exceeding 7 feet, it is recommended to use (2) two half sizes (i.e. for 10 foot fence use two 5 foot slats) (Special heights available upon request).

2.05 GATE POSTS

A. Double drive gates up to 12 feet wide: 2-7/8 inch outside diameter iron pipe weighing 5.79 pounds per foot or approved equal.

B. Double drive gates from 12 feet to 16 feet wide: 4-inch outside diameter iron pipe weighing 9.11 pounds per foot or approved equal.

C. Double drive gates from 16 feet to 24 feet: 6-5/8-inch outside diameter iron pipe weighing 18.97 pounds per foot or approved equal.

2.06 POST TOPS

A. Pressed steel or malleable iron designed as a weather tight closure cap for tubular posts.

B. Provide one cap for each post, unless equal protection is afforded by combination post top cap and barbed wire supporting arm where barbed wire is required.

C. Where top rail is used, provide tops to permit passage of top rail.

2.07 FABRIC TIES

A. No. 9 aluminum wire of approved design for use on line posts every 14 inches and on top rails every 24 inches.

2.08 BRACE AND TENSION BANDS

A. Unclimbable type with 5/16-inch diameter square-shouldered steel carriage bolts, non-removable from outside fence.

2.09 TENSION BARS

A. For attaching fabric to terminal posts: 3/16 inch by 3/4-inch-high carbon steel attached to terminal post by means of beveled edge bands.

2.10 TOP RAIL

A. 1-5/8 inch outside diameter seamless steel pipe weighing 2.27 pounds per lineal foot or approved equal.

B. Galvanized by hot-dip process after fabrication.

C. To pass through bases of extension arms and form a continuous brace from end to end of each section of fence.

D. Provide with expansion rail couplings and suitable hot-dip galvanized connections.

2.11 BRACE PIPE

A. Same material as the top rail.

2.12 TENSION WIRE

A. Hot-dip galvanized No. 7 gage steel. Class III

2.13 MISCELLANEOUS FITTINGS

A. Ferrous fittings required to make a complete installation to the malleable iron, pressed steel, aluminum, or forgings shall be hot-dip galvanized.

2.14 GATES

A. Manufacturer: Same as fence manufacturer.

B. Frames: 1.9-inch outside diameter steel pipe weighing 2.7 pounds per lineal foot with necessary intermediate braces of 1.66-inch outside diameter steel pipe weighing 2.27 pounds per lineal foot.

C. Pipe, fittings, stretcher bars, hook bolts, hinges, latches, truss-rods, and other accessories: Heavily galvanized by the hot-dip process.

D. Gate Fabric. Match fence fabric.

E. Latches for double drive gates shall be drop bar type securely bolted to gate and to engage a pipe gate stop anchored in domed concrete footings and to allow for locking with padlock.

F. Latches for walk gate shall be fork type latch that will automatically engage latch post and fitted for padlock.

G. Hinges shall be of heavy, industrial type, hot-dip galvanized, offset type, allowing gates to swing back parallel with line of fence.

2.15 CONCRETE

A. Materials as specified in Section 03 01 00 – Site Concrete Work.

B. Compressive strength: Not be less than 3,000 psi at 28 days.

PART 3 - EXECUTION

3.01 PREPARATION

A. Where fence traverses areas not cleared, clear a strip 10 feet wide with 2 feet outside of fence line and 8 feet on the inside of fence line.

3.02 FENCE

A. Erect fencing in straight lines between angle points by skilled personnel experienced in this type of construction.

B. Erect in accordance with the manufacturer's recommendations as approved and with these Specifications.

C. The top rail of the fence shall be at the top of the fabric.

D. Fasten chain link fabric to end posts with stretcher bars and clamps at approximately 14-inch centers and to line posts and top rail with wire or bands at approximately 24-inch centers.

3.03 POST SPACING AND SETTING

A. Post Holes:
   1. Minimum depth of post holes: 3 feet below finished grade.
   2. Holes for line posts: 12 inches in diameter.
   3. Holes for gate, corner, and pull posts: 15 inches in diameter.

B. Space posts not more than 10 feet on centers and in true lines.

C. Set posts plumb and to a depth not less than 2 feet 10 inches.

D. Fill remainder of hole with concrete.

E. The top surface of the foundation shall extend above finished grade not less than 1 inch and shall have a crown watershed finish

F. After concrete has set, install accessories.

3.04 GATES

A. Brace gate posts diagonally to adjacent line posts to ensure stability.

B. Hang gates and adjust hardware so that gates operate satisfactorily from open or closed position.

3.05 BRACING

A. Install brace pipe midway between the top rail and extend from the terminal post to the first adjacent line post.

B. Fasten securely to the posts by heavy-pressed steel and malleable fittings.

C. Truss securely from line post to base of terminal post with a 3/8-inch truss rod and tightener.

3.06 CLEANUP

A. Upon completion of the fence installation, clean up waste material resulting from the operation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Division 01 Specification Sections included in the Project Manual, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hand-woven wire mesh enclosures.
      a. Vertical wall installations.
      b. Horizontal lid cover structures.
   2. Wire mesh support framework.
   3. Swing gate openings.
   4. Accessories.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of product and gate assembly.
   1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For structural performance and sizing of structural elements of hand-woven wire mesh animal enclosures and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.6 WARRANTY

A. Special Warranty: Manufacturer/Installer agrees to repair or replace components of hand-woven wire mesh enclosures and gates that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design hand-woven wire mesh enclosures and gate openings.

B. Structural Performance: Hand-woven wire mesh enclosures and gate openings shall withstand the design wind loads and stresses for the enclosure height(s) and under exposure conditions indicated according to ASCE/SEI 7:
   1. Design Wind Load: As indicated on the Structural Drawings.
   2. Main Support: Steel perimeter pipe columns, or center pipe columns, and foundations as indicated on the Delegated Design Drawings and approved shop drawings.
   3. Primary Support Cables: Steel primary support cables of size and design as indicated on the Delegated Design Drawings and approved shop drawings.
   4. Secondary Interlacing Cables: Designed by hand-woven wire mesh manufacturer/installer.
   5. Concrete Perimeter Footings: As designed and as shown on the Delegated Design Drawings and approved shop drawings.

2.2 HAND-WOVEN WIRE MESH (M6)

A. Manufacturers: Basis-of-Design: Furnish hand-woven observation wire mesh enclosure by “A Thru Z Consulting and Distributing, Inc.” (https://athruzcad.com) as shown on the Drawings.

B. General: Provide fabric in single-piece heights measured across maximum opening dimension between structural support members and requirements indicated below:
   1. Fabric Height: Varies, and as indicated on the Drawings.
   2. Steel Wire for Fabric: Wire diameter as indicated on Drawings.
      a. Material: AISI 304 stainless steel, with Black Oxide finish.
      b. Mesh Aperture: As indicated on Drawings.
      c. Panel Size: As indicated on Drawings.

2.3 ENCLOSURE FRAMEWORK

A. Perimeter Primary Columns: Comply with ASCE 7 and as shown on the Delegated Design Drawings and approved shop drawings.

B. Posts and Cables: Steel posts and steel cabling, including down guys, clevices, turnbuckles, and other fittings. Provide members with minimum dimensions as indicated on Drawings, based on the following:
   1. Enclosure Height: As indicated on Drawings.
   2. Heavy-Industrial-Strength Material: Group IA, steel sections and sizes vary as shown on Drawings.
      a. Perimeter and Center Posts: As required and/or as indicated on Drawings.
   3. Metallic Coating for Steel Framework:
      a. External: Type B zinc with organic overcoat.
      b. Internal: Type D zinc-pigmented coating.
   4. Polymer Coating Over Metallic Coating:
      a. Color: Black, according to ASTM F934.
      b. As indicated in Section 09 91 00 “Painting.”

2.4 TENSION WIRE

A. Stainless-steel wire of size required for application.
   1. Color: Match hand-woven mesh color.

2.5 SWING GATES

A. General: ASTM F900 for gate posts and single- or double-swing gate types, as indicated on the Drawings.
   1. Gate Leaf Width: 36 inches, unless otherwise indicated on Drawings.
   2. Framework Member Sizes and Strength: Based on gate fabric height as indicated on the Drawings.

B. Pipe and Tubing:
   1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match enclosure framework
   2. Gate Posts: Tubular steel, as shown on Drawings.
   3. Gate Frames and Bracing: Tubular steel, as shown on Drawings.

C. Frame Corner Construction: Fully welded.

D. Hardware:
   1. Hinges: 360-degree inward and outward swing.
   2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
   3. Lock: Match facility’s “PACKLOCK” padlock system. Padlocks will be furnished by Owner.

2.6 FITTINGS

A. Provide fittings according to ASTM F626.

2.7 FOUNDATIONS, GROUT AND ANCHORING CEMENT

A. Perimeter Concrete Footings and Main Column Foundations: As indicated in the Delegated Design Drawings and approved shop drawings, and in accordance with Section 03 30 00 “Cast-in-Place Concrete.”

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

C. 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. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

3.2 PREPARATION

A. Stake locations of enclosure lines, gates, and terminal posts. Do not exceed intervals of 25 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 HAND-WOVEN WIRE MESH ENCLOSURE INSTALLATION

A. Install hand-woven fabric according to manufacturer’s installation instructions and per requirements indicated in the approved shop drawings.

B. Main Column Excavation: Perform excavation of main column foundations at indicated spacings and to a depth indicated on Delegated Design Drawings and approved shop drawings, in firm and undisturbed soil.

C. Perimeter Footings: Excavate perimeter trench footings to indicated depth, as shown on approved shop drawings, in firm and undisturbed soil.

D. Column Setting: Set columns and anchor to concrete footings as shown on approved shop drawings.

1. Verify that columns are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

E. Exposed Concrete Footings: Extend 1 inch above grade; shape and smooth to shed water. Chamfer exposed edges.

F. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of columns. Pull wire taut, 6-inch maximum sag. Fasten fabric to tension wire with 0.120-inch-minimum-diameter lacing cable of same material and finish as fabric wire. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
   1. Extended along top of wire mesh enclosure and where required for proper installation of the wire fabric.
   2. Install tension wire as indicated on Drawings and/or required between hand-woven wire mesh sections and interlace edges for proper and complete installation of wire mesh enclosure.

G. Hand-Woven Wire Mesh Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface of perimeter concrete footing and bottom selvage unless otherwise indicated. Pull fabric taut and tie to columns, posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

3.4 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 32 31 13.13

PART 1 - GENERAL

1.01 SUMMARY

A. This item shall consist of furnishing and applying lime, fertilizer, seed, mulch cover, and water according to these specifications at locations shown on the plans or as directed.

B. The work under this item shall be accomplished as soon as practicable after the grading in an area has been completed in order to deter erosion.

PART 2 - MATERIALS

2.01 TOPSOIL

A. Existing topsoil shall be reused where practical.

B. Imported Topsoil:
   1. Furnished at sole expense of Contractor.
   2. Friable loam free from subsoil, roots, grass, excessive amounts of weeds, stone, and foreign matter; acidity range (pH) of 5.5 to 7.5; and containing a minimum of 4 percent and a maximum of 50 percent organic matter.

2.02 LIME

A. Lime shall be agricultural grade ground limestone or equivalent as approved by the Engineer.

2.03 FERTILIZER

A. Fertilizer shall be a commercial grade, uniform in composition, free flowing, and suitable for application with mechanical equipment.

B. Fertilizer shall be delivered to the site in labeled containers conform to current Arkansas fertilizer laws and bearing the name, trademark, and warranty of the producer.

2.04 SEED

A. Seed shall have a minimum of 98% pure seed and 85% germination by weight, and shall contain no more than 1% weed seeds.

B. A combined total of 110 noxious weed seeds shall be the maximum amount per 50 pounds of seed with the following exceptions: Johnson grass seed, wild onion seed, wild garlic seed, field bindweed seed, nut grass seed, sickle pod seed, sesbania seed, indigo seed, morning-glory seed, and cocklebur seed will not be allowed in any amount.

C. Seed shall be furnished in sealed, standard containers. Seed that has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.

D. Legumes shall be inoculated with an approved culture as recommended by the manufacturer, just prior to seeding.

E. Seeds shall be composed of the varieties and amounts by weight as shown below.

2.05 SEED MIX

A. Seed shall be Common Bermuda Grass, applied at the following rates:

	lbs./acre
March 1 - August 31	
Bermuda Grass (Common) unhulled - husk in tact	10
Bermuda Grass (Common) hulled - husk removed	5
September 1 - February 28/29	
Bermuda Grass (Common) unhulled - husk in tact	20

2.06 MULCH COVER

A. Mulch cover shall consist of straw from threshed rice, oats, wheat, barley, or rye; of wood excelsior; or of hay obtained from various legumes or grasses, such as lespedeza, clover, vetch, soybeans, bermuda, carpet sledge, bahia, fescue, or other legumes or grasses; or a combination thereof. Mulch shall be dry and reasonably free from Johnson grass or other noxious weeds, and shall not be excessively brittle or in an advanced state of decomposition. All material will be inspected and approved prior to use.

2.07 TACKIFIERS

A. Tackifiers used in mulch anchoring shall be of such quality that the mulch cover will be bound together to form a cover mat that will stay intact under normal climatic conditions.

2.08 WATER

A. Water shall be of irrigation quality and free of impurities that would be detrimental to plant growth.

PART 3 - EXECUTION

3.01 PROJECT SCHEDULE

A. Project Schedule shall show an anticipated time for grading and seeding to take place, so that seasonal consideration can be given attention.

3.02 SITE GRADING

A. Shape, trim, and finish slopes to conform with lines and grades shown.

B. Make slopes free of loose exposed roots and stones exceeding 2 inches in diameter.

C. Ensure that site drains properly and there are no areas where water may pond.

D. Finished site grading will be reviewed by Engineer.

3.03 PREPARATION OF SEEDBED

A. Areas to be seeded shall be dressed to the shape and section shown on the plans.

B. If the plans call for replacing topsoil, this shall be done before any preparations for seeding.

C. Before beginning the seedbed preparation, soil samples shall be obtained from each major soil area for lime requirement analysis.

D. Lime at the rate determined by the lime requirement test, shall be uniformly spread on areas to be seeded prior to their being roughened or scarified. The seedbed shall be thoroughly pulverized by means of disk harrows or other approved methods, thoroughly mixing lime and soil to a depth of not less than 4 inches (2 inches for slopes 4:1 or steeper) below finish slope elevations. Regardless of the pulverizing method used, the soil shall be broken with the contour of the slope.

E. Objectionable foreign matter shall be removed and the soil left in a suitable horticultural condition to receive fertilizer and seed. Water may be applied before, during, and after seedbed preparation in order to maintain the desired moisture content in the soil.

F. When no lime is required, seedbed preparation shall be accomplished as specified above, regardless of the method used in the distribution of fertilizer, seed, and mulch cover.

G. Rake the area to a uniform grade so that areas drain in the same manner as at the start of the Project.

H. Lightly compact before planting grass.

I. Remove trash and stones exceeding 2 inches in diameter from area to a depth of 2 inches prior to preparation and planting grass.

3.04 FERTILIZATION

A. Fertilizer shall be applied at the rate of 800 pounds per acre of 10-20-10. Fertilizer shall be uniformly incorporated into the soil alone, or in conjunction with the required lime. If the Contractor so elects, the fertilizer may be drilled into the soil or combined with the seed in the hydro-seeding operation.

3.05 TIME OF SEEDING

A. Conduct seeding under favorable weather conditions during seasons which are normal for work as determined by accepted practice in locality of Project.

3.06 MECHANICAL SEEDING

A. Sow grassed areas evenly with a mechanical spreader, or as otherwise instructed by the Engineer. Roll with cultipacker to cover seed. Method of seeding may be varied at discretion of Contractor on his own responsibility to establish a smooth, uniformly grassed area.

3.07 HYDRO-SEEDING

A. If hydro-seeder is used for seeding, fertilizer and seed may be incorporated into one operation but a maximum of 800 pounds of fertilizer shall be permitted for each 1500 gallons of water. If the Contractor so elects, the fertilizer may be applied during preparation of the seedbed. The area shall be lightly firmed with a cultipacker immediately before hydro-seeding.

3.08 WINTER PROTECTIVE SEEDING

A. Winter barley or annual rye grass applied at a rate of 30 pounds/acre shall be used between September 1 and March 1.

B. Areas receiving temporary winter protective seeding shall be re-seeded when weather conditions become favorable.

3.09 MULCH COVER

A. Mulch cover shall be applied at the rate of 4,000 pounds per acre immediately after seeding and shall be spread uniformly over the entire area by approved power mulching equipment. When approved by the Engineer, the Contractor may use hand methods to apply mulch cover too small or inaccessible areas.

3.10 MULCH ANCHORING

A. The mulch shall be effectively pressed into the soil using steel cleated track or cleated roller equipment. The anchoring shall be performed so that the grooves formed are perpendicular to the flow of water down backslopes and foreslopes. The equipment and method used shall produce acceptable results.

3.11 WATER

A. After application of the mulch cover, water shall be applied in sufficient quantity, as Directed by the Engineer, to thoroughly moisten the soil to the depth of pulverization and then as necessary to germinate the seed.

B. When directed by the Engineer, the Contractor shall apply water in an amount such that, in conjunction with any rainfall, the seeded and mulched area will receive an amount equivalent to a minimum of 1 inch of water each week beginning the week after seeding and continuing for a minimum of 3 weeks.

3.12 MAINTENANCE

A. Begin maintenance immediately after each portion of grass is planted and continue until a reasonable stand of grass has been obtained. Repair washed out areas by filling with topsoil, fertilizing, and seeding.

3.13 GUARANTEE

A. If, at the end of a 180-day period, a satisfactory stand of grass has not been produced, the Contractor shall renovate and reseed the grass or unsatisfactory portions thereof immediately, or, if after the usual planting season, during the next planting season. If a satisfactory stand of grass develops by July 1 of the following year, it will be accepted. If it is not accepted, a complete replanting will be required during the planting season.

B. A satisfactory stand is defined as grass or section of grass that has:
   1. No bare spots larger than 1 square foot.
   2. Not more than 15 percent of total area with bare spots larger than 6 inches square.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. The work under this item shall be accomplished as soon as practicable after clearing and grubbing in an area has been completed in order to deter erosion of the site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Nonvegetative Soil Stabilization:
   1. Utilize temporary nonvegetative soil stabilization to provide protection against excessive soil erosion over a short-term period (less than one year).
   2. Nonvegetative methods shall be required in areas that experience high water flows and high runoff velocities (disturbed slopes steeper than 2:1).
   3. Methods employed include mulching, chemical soil stabilizers (binders), brush and slash, and netting and matting.
   4. Mulch shall consist of straw, hay, or salt hay applied at an appropriate rate 70-115 pounds per 1000 square feet (1.5 to 2.5 tons/acre). Mulch anchoring shall be implemented promptly where applicable and achieved by one of the following methods:
      a) Peg and twine.
      b) Mulch netting.
      c) Erosion control.
      d) Jute matting, as indicated on Drawings.
      e) Mulch anchoring tool.

B. Temporary Seeding and Revegetation:
   1. Soil that is stockpiled for more than 30 days or disturbed areas where there will be no construction for 12 months shall be stabilized to prevent erosion.
   2. If natural vegetation does not occur, area shall be temporarily seeded.
   3. Temporary revegetation shall occur during the spring and summer period.
   4. If required to temporary revegetate an area during the fall or winter period, a mixture of Austrian winter pea, rye, oats, and wheat shall be used.
   5. Provide a combination of milo, millets, and the Arkansas mix for temporary revegetation to control erosion. The use of a broadcast seeder after the last frost through July is acceptable.
   6. Alternative to Temporary Seeding: Mulching using the methods and rates give in this Section.

C. Seed:
   1. Certified, blue tag, clean, delivered in original, unopened packages and bearing an analysis of the contents, guaranteed 95 percent pure and to have a minimum germination rate of 85 percent, within 1 year of test.

2.02 SEED MIX

A. Mix for areas: Common Bermuda Grass. Follow the recommendations of the local Agricultural Extension Agent for requirements on coverage, fertilization, and seasons.

PART 3 - EXECUTION

3.01 PROJECT SCHEDULE

A. Project Schedule will dictate when seeding needs to take place.

3.02 SITE GRADING

A. Shape, trim, and finish slopes to conform with lines, grades, and cross sections shown.

B. Make slopes free of loose exposed roots and stones exceeding 3-inch diameter.

C. Ensure that site drains properly and there are no areas where water may pond.

D. Grading will be reviewed by Engineer.

3.03 GRADING OF TOPSOIL

A. Shape the topsoil over the area to the desired shape and contour.

B. Apply commercial fertilizer at the Agricultural Extension Agent's recommended rate, distributing it uniformly with a mechanical spreader.

3.04 FINISH GRADING

A. Thoroughly mix the topsoil and fertilizer.

B. Rake the area to a uniform grade so that areas drain in the same manner as at the start of the Project.

C. Lightly compact before planting grass.

D. Remove trash and stones exceeding 2 inches in diameter from area to a depth of 2 inches prior to preparation and planting grass.

3.05 TIME OF SEEDING

A. Conduct seeding under favorable weather conditions during seasons which are normal for work as determined by accepted practice in locality of project.

3.06 MECHANICAL SEEDING

A. Sow grassed areas evenly with a mechanical spreader at rate of 100 pounds per acre, minimum, or as otherwise recommended by the Agricultural Extension Agent. Roll with

cultipacker to cover seed, and water with fine spray. Method of seeding may be varied at discretion of Contractor on his own responsibility to establish a smooth, uniformly grassed area.

3.07 HYDROSEEDING

A. Seed may be applied by hydroseeding method. Seeding shall be done within 10 days following soil preparation. Hydroseed areas at rate of 100 pounds seed and 500 pounds ammonium phosphate per acre, minimum, or as otherwise recommended by the Agricultural Extension Agent.

B. Proceed with seeding operation on moist soil, but only after free surface water has drained away.

C. Exercise care to prevent drift and displacement of mixture into other areas.

3.08 WINTER PROTECTIVE SEEDING

A. Winter barley or annual rye grass applied at a rate of 120 pounds/acre shall be used after September 15 or as recommended by the Agricultural Extension Agent.

B. Areas receiving temporary winter protective seeding shall be re-seeded when weather conditions become favorable.

3.09 MULCH COVER

A. Mulch cover shall be applied, at the rate of 4,000 pounds per acre, immediately after seeding and shall be spread uniformly over the entire area by approved power mulching equipment. When approved by the Engineer, the Contractor may use hand methods to apply mulch cover too small or inaccessible areas. If the Contractor so elects, an approved mulching machine may be used whereby the application of mulch cover and tackifier may be combined into one operation. If this method is used, no change in application rates will be allowed.

B. In its final position, the anchored mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and reduce the impact of rainfall on the surface of the soil.

3.10 MULCH ANCHORING

A. Immediately following or during the application of the mulch cover on seeded areas, the mulch shall be anchored by one of the following methods:
   1. Tracking or Roller Method - The mulch shall be effectively pressed into the soil using steel cleated track or cleated roller equipment. The anchoring shall be performed so that the grooves formed are perpendicular to the flow of water down backslopes and foreslopes. The equipment and method used shall produce acceptable results.

2. Asphalt Tackifier - Asphalt shall be applied at the rate of approximately 0.05 gallon per square yard. Application shall be made using a pressure distributor to ensure constant and uniform distribution. The use of asphalt may be reduced or eliminated by the Engineer at selected locations.

3.11 MAINTENANCE

A. Begin maintenance immediately after each portion of grass is planted and continue until a reasonable stand of grass has been obtained.

B. The Contractor shall apply water in an amount such that, in conjunction with any rainfall, the seeded and mulched areas will receive an amount equivalent to a minimum of 1-inch of water each week beginning the week after seeding and continuing for a minimum of three (3) weeks.

C. Actual work and materials required due to the Contractor's negligence in maintaining completed work or failure to water grass as directed shall be accomplished at no cost to the Owner. If payments are withheld and subsequently a stand of grass satisfactory to the Engineer develops, payments will be released.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Artificial Vines and Ropes:
   1. Flex Vines: Artificial Vines and Ropes with hanging clamps of various sizes.
   2. Recommended anchors, hanging clamps, clips, spacers, buckles, and attachment hardware.

B. Delegated Design: Manufacturer shall engage a licensed Engineer familiar with Artificial Vines and Ropes fabrication and installation procedures. Engineer shall design and furnish calculations indicating the required material strength and anchoring systems for the intended applications. Design and material performance calculations, material types, and required anchoring systems shall be signed and sealed by the licensed Engineer.

C. Artificial Vines and Ropes Contractor shall coordinate the Work with the Artificial Themework Contractor for the creation of the artificial environments required in this facility, and for each of the represented animal species. Mock-ups of the Artificial Themework incorporating the Artificial Vines and Ropes shall be approved by the Owner and the Architect prior to fabrication and installation of the specified materials.

1.2 RELATED SECTIONS

A. Section 03 30 00 “Cast-In-Place Concrete” (concrete footings).

B. Section 03 37 13 “Shotcrete” for attachments to Artificial Rockwork.

C. Section 03 37 20 “Artificial Themework” for overall aesthetic within artificial environment, and functional installation.

D. Section 05 10 00 “Structural Steel” for attachment to steel posts and columns.

E. Section 06 13 00 “Whole Tree Construction” for attachment to real trees within exhibit.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.
   2. ASTM F1554 – Steel Anchor Bolt Requirements.
   3. ASTM F593 – Stainless Steel Anchor Bolt Requirements.

B. The Aluminum Association, Inc. (AA):
   1. AA ADM-1516166 - Aluminum Design Manual.

C. American Society of Civil Engineers (ASCE):
   1. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 “Submittal and Substitution Procedures.”

B. Product Data:
   1. Manufacturer's data sheets on each product to be used.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Typical installation methods.
   5. Sufficient data and detail to indicate compliance with these Specifications.

C. Verification Samples: 2 representative units of each material type.
   1. Artificial Vine and Rope diameter size.
   2. Termination hanging clamp configuration and materials.
   3. Composition.
   4. Color.

D. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Paints and materials shall be non-toxic to the animals and be UV resistant.

E. Shop Drawings: Indicate layout heights, length, diameter and component connection details, and details of interface with adjacent construction.
   1. Type of Mounting System: Wall material, steel post, or tree to be attached to.

F. Certification: Manufacturer's Certificate of Compliance certifying that Artificial Vines and Ropes supplied meet or exceed requirements specified.

G. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with a minimum of 5 years’ documented experience.

B. Installer Qualifications: Company specializing in performing Work of this Section with minimum 2 years’ documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect.
   1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
   2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
   3. Retain mock-up during construction as a standard for comparison with completed work.

4. Do not alter or remove mock-up until work is completed or removal is authorized.
5. Approved mock-up may be incorporated at the final installation as acceptable to the Owner.

1.6 PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately 2 weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage and Handling: Keep product in original package until ready to install to protect materials and finishes during handling and installation.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

B. Field Measurements: Take measurements of actual distances to install Artificial Vines and Ropes. Indicate measurements on shop drawings fully documenting any field condition that may interfere with installation.

1.9 COORDINATION

A. Manufacturer and Installer shall meet with the Owner prior to material fabrication and/or installation to discuss animal behavioral characteristics and requirements for proper Vines and Ropes selection, material composition, and sizing.

B. Installer for Work under this Section shall be responsible for coordination with the Contractor's requirements.

C. Submit shop drawings for review, and obtain written approval from the Architect, prior to fabrication.

1.10 WARRANTY

A. If any part of the Artificial Vines and Ropes system fails because of a manufacturing defect within 5 years from the date of Substantial Completion, the manufacturer will furnish without charge the required replacement parts. Transportation, related service labor or diagnostic site visits, are not included within this Warranty.

B. Warranty shall include material failure in discoloration and/or material deterioration due to inadequate UV resistance.

C. This warranty does not cover failure of the Artificial Vine and Rope System, if the Owner or Visitors to the Exhibits damages it. In no event shall Warrantor be liable for incidental or consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Zoological Fabrications Inc., 521 Broadway Street, Vallejo, CA 94590. Telephone: (707) 561-0834; https://zoofab.com.

B. Basis of Design: Flex Vine and Rope System as manufactured by Zoological Fabrications Inc.

C. Substitutions: Not permitted.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.

B. Design Criteria:
1. Manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist applicable dead and live loading at any point without damage.
2. Furnish applicable testing of materials by a licensed testing facility indicating actual performance and load resistance characteristics of proposed materials.
3. Anchoring system shall be designed in accordance with applicable Standards, Code and Regulations to resist the applicable loading.

2.3 MATERIALS

A. Artificial Vines and Ropes: Materials recommended by the manufacturer shall be approved by the Architect and the Owner. Artificial Vines and Rope materials and finishes shall be non-toxic to the animals and shall be UV resistant.

B. Vines and Rope Terminations: Provide hanging clamp ends as required for application and future maintenance and required replacements.

C. Size: Artificial Vines and Ropes shall be sized as indicated on the Drawings and according to the specific application, type of animal species to be accommodated, and be approved by the Architect and the Owner.

D. Fasteners (Hanging Clamps, Buckles, Screws, Bolts, Nuts and Washers): Stainless-steel, or powder coated metal as required for the application.

2.4 FABRICATION

A. Manufacturer's standard process.

2.5 FINISHES

A. Manufacturer's "Salting" process for the Vines and Ropes, as required, by spreading grit on the final finish coat.
   1. Texture: Varying texture per specific application.
   2. Color: Naturalistic blending with adjacent Themework, and as selected by the Architect and the Owner from full range of manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer's Examination: Examine conditions under which construction activities of this Section are to be performed.
   1. Submit written notification to Architect and Artificial Vines and Ropes manufacturer if such conditions are unacceptable.
   2. Beginning erection constitutes installer's acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
   1. Verify appropriate size and length of Artificial Vines and Ropes for specific applications.
   2. Mounting: Structurally secured based on loading, on steel posts, trees or adjacent artificial rock formations.

3.4 CLEANING AND PROTECTION

A. Do not use abrasive cleaners.

B. Protection:
   1. Ensure that finishes and installed systems are not damaged by subsequent construction activities.
   2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations.

C. Prior to Substantial Completion: Remove dust or other foreign matter from material surfaces; clean finishes in accordance with manufacturer's instructions.

END OF SECTION 32 95 10

PART 1 - GENERAL

1.01 SUMMARY

A. This Section covers test for water appurtenances and piping.

1.02 RELATED SECTIONS

A. Section 33 14 01 – PVC Water Pipes and Fittings.

1.03 SUBMITTALS

A. Submit testing procedures in accordance with Specifications.

PART 2 - MATERIALS

2.01 WATER FOR HYDROSTATIC TESTING OF PRESSURE LINES

A. Furnish water from the nearest hydrant or other suitable source for testing purposes.

PART 3 - EXECUTION

3.01 HYDROSTATIC AND LEAK TESTING OF PRESSURE LINES

A. Upon completion of installation, thoroughly clean new pipe:
   1. Flush with water to remove dirt, stones, pieces of wood, or other obstructions that may have entered pipe during construction.
   2. Flush pipelines at a minimum rate of 2.5 feet per second for a duration suitable to Engineer.

B. Upon completion of installation, pressure test water pipelines:
   1. Conduct test in presence of Engineer and Owner.
   2. Minimum Pressure: 100 psig measured at the lowest elevation of the line.
   3. Duration: 2 hours.
   4. Repair visible leaks regardless of the amount of leakage.

C. Provide water into pipeline for testing and flushing, including necessary:
   1. Pumps, gages (increment at 10 psi or less), and meters.
   2. Plugs and caps.
   3. Temporary blowoff piping to discharge water.
   4. Reaction blocking to prevent pipe movement during testing.

D. Water source for the pump suction shall be potable water from the Owner's distribution system; vessel used shall be approved by the Engineer.

E. Prevent contamination of the Owner's water distribution system.

F. After pipelines or isolated sections of pipelines have been filled with water, increase the pressure to test pressure by means of a pump.

G. Test pressure shall be 100 psi or 50 percent above normal operating pressure, whichever is greater for tow (2) hours, except at the lowest elevation of the line, where the test pressure shall be 125 psig or 50 percent above normal operating pressure, whichever is greater.

H. Duration of hydrostatic leakage test shall be 2 hours, or as specified by Engineer.

I. Open interior valves, including fire hydrants and other appurtenances, open during tests.

J. After the specified test pressure has been applied, the entire pipeline shall be checked in the presence of the Engineer giving particular attention to parts of the pipeline and the appurtenances that are exposed.

K. If leaks are apparent, perform corrective work and replace material that is required to remedy the defect and stop the leaks at no extra cost to the Owner.

L. If no leaks were apparent or after corrective work has been completed, the pipelines shall be subjected to a leakage test at the pressure specified with a meter inserted in the test pump discharge line.

M. AWWA C600 (current edition) leak test for Ductile Iron.

1. Hydrostatic Testing shall comply with Section 5.2 of AWWA C600 (current edition).
2. Leakage Criteria to follow AWWA C600 (current edition) Section 5.5.1.4 “Test Allowance.”

$$L = \frac{S \times D \times (P^{0.5})}{148{,}000}$$

L = Quantity of makeup water in gallons per hour
S = Length of pipe section being tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Use Table 5A for Hydrostatic Testing Allowances per 1,000 ft. of pipline.

N. AWWA C605 (current edition) leak test for PVC.

1. Hydrostatic Testing shall comply with Section 10.3 of AWWA C605 (current edition).
2. Leakage Criteria to follow allowable criteria found in AWWA C605 (current edition) Section 10.3.6 “Test Allowance.”

$$Q = \frac{L \times D \times (P^{0.5})}{148{,}000}$$

Q = Quantity of makeup water in gallons per hour
L = Length of pipe section being tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

This formula is based on a testing allowance of 10.5 GPD/mile/inch of nominal pipe diameter at a test pressure of 150 psi.

O. If test of pipe laid discloses leakage greater than the allowable leakage as calculated from the above formula, locate the leak or leaks and perform corrective work and replace material that is required in order to remedy the defect and stop the leak.

P. Corrective work shall be approved by Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Provide cement-lined ductile iron pipe and gray cast iron or ductile iron fittings specified.

B. Pipe and fittings shall be manufactured in the United States. Foreign made products shall be unacceptable.

C. Service shall include potable waterline.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling.

1.03 REFERENCES

A. American National Standards Institute, 25 West 43rd Street, 4 floor, New York, NY, 10036.
   1. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   2. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings, 3 in Through 48 in, for Water and other Liquids.
   3. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Fittings Pressure Pipe and Fittings.
   4. ANSI/AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges.
   5. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
   6. NSF/ANSI 61 - Drinking Water System Components - Health Effects.

B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
   1. ASTM A307 - Specifications for Carbon Steel Externally Threaded Standard Fasteners.
   2. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
   3. ASTM D1248 - Specification for Polyethylene Plastic Molding and Extrusion Materials.

C. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
   1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids.
   2. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
   3. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
   4. AWWA C207 - Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. Through 144 in.

PART 2 - PRODUCTS

2.01 PIPE

A. Buried Pipe: Pressure Class 250 or 300, as shown on Drawings and in compliance with applicable requirements of ANSI A21.50. Flanged pipe shall meet or exceed ANSI/AWWA C115/A21.15.

B. Pipe shall be jointed with push-on, mechanical, flanged, restrained, or flexible joints meeting applicable requirements of ANSI A21.11-72 and ANSI 21.15-75.

C. Ductile iron pipe shall receive standard thickness cement lining and bituminous seal coat in conformance with ANSI/AWWA C104/A21.4.

D. Ductile iron pipe shall be coated on the exterior with either coal tar or asphalt base material approximately 1 mil thick.

E. Flexible Joint (Ball and Socket) Pipe: Class 58.

2.02 FITTINGS

A. Ductile iron, Pressure Class 250 or 300 Class as shown on Drawings, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
   1. Flanged Joint: ANSI/AWWA C115/A21.15, faced and drilled. 125-pound ANSI standard.
   2. Mechanical Joint: ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
   3. Flexible Joint: American Flex-Lox pipe or equal.

B. Cement Linings:
   1. In accordance with ANSI/AWWA C104/A21.4
   2. Certified to be in compliance with NSF/ANSI 61.

C. Fittings shall receive an exterior coating of 1 mil thick bituminous material in accordance with ANSI/AWWA C104/A21.4.

D. Fittings shall have distinctly cast on them the manufacturer's identification, pressure rating, nominal diameter of openings, and the number of degrees or fraction of the circle on bends.

2.03 FLANGES

A. ANSI/AWWA C115/A21.15, threaded, 250 psi working pressure, ANSI 125-pound drilling.

2.04 BOLTS

A. For Class 125 FF flanges use carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

B. For Class 250 RF flanges use carbon steel, ASTM A307, Grade B hex head bolts and ASTM A563, Grade A heavy hex head nuts.

C. For mechanical joint use manufacturer's standard.

2.05 GASKETS

A. Gaskets for mechanical joints shall be rubber, conforming to ANSI/AWWA C111/A21.11.

B. Gaskets for flanged joints shall be 1/8-inch thick, cloth-inserted rubber conforming to applicable parts of ANSI/AWWA C115/A21.15 and AWWA C207.

C. Gasket Material: Free from corrosive alkali or acid ingredients and suitable for use in potable waterlines.

D. Gaskets shall be full-face type for 125-pound FF flanges.

2.06 LUBRICANT

A. Lubricant for push-on or mechanical joint end piping shall be manufacturer's standard.

PART 3 - EXECUTION

3.01 HANDLING PIPE

A. Do not damage the cement lining when handling the pipe.

3.02 RELATION TO SEWER LINE

A. Laying water main, follow Health Department requirements. Maintain 10-foot horizontal separation and 18-inch vertical separation in crossing.

3.03 CUTTING PIPE

A. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.

3.04 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.

C. Dress cut ends of pipe for flexible couplings and flanged coupling adapters as recommended by the coupling or adapter manufacturer.

3.05 MECHANICAL JOINT

A. Join pipe with mechanical joints in accordance with the manufacturer's recommendations. Provide special tools and devices, special jacks, chokers, and similar items required for proper installation. Pipe manufacturer shall provide lubricant for the pipe gaskets, no substitutes shall be permitted.

3.06 FABRICATION OF FLANGED PIPE AND FITTINGS

A. Flanged pipe and fittings shall be fabricated in the shop, not in the field, and delivered to the job site with flanges in place and properly faced.

B. Threaded flanges shall be individually fitted and machine tightened on the threaded pipe by the manufacturer.

C. Flanges shall be faced after fabrication in accordance with ANSI/AWWA C115/A21.15.

3.07 JOINTING FLANGED PIPE

A. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of oil, grease, and foreign material.

B. The rubber gaskets shall be checked for proper fit and thoroughly cleaned.

C. Care shall be taken to assure proper seating of the flanged gasket.

D. Bolts shall be tightened so that the pressure on the gasket is uniform.

E. Torque-limiting wrenches shall be used to ensure uniform bearing insofar.

F. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.

3.08 THRUST BLOCKS

A. Install 2,500 psi concrete thrust blocks at bends, wyes, or other thrust points on pressure piping.

B. Block to bear against undisturbed soil and shall be of size and with bearing area as shown on Drawings.

3.09 TESTING

A. Lines shall be hydrostatically or pneumatically tested. Test procedures shall be as specified in Section 33 05 05.31.

3.10 POLYETHYLENE MATERIAL FOR DUCTILE IRON PIPE PROTECTION

A. Polyethylene material, either in tubing form or flat sheets or rolls, as specified herein, shall be placed around all Ductile Iron pipe and fitting joints and all valves and fire hydrants with mechanical joint ends, and all saddles, sleeves, couplings, tapping saddles and any other appurtenances with exposed bolts, as directed by the Owner. Ductile iron pipe and appurtenances shall be completely encased in polyethylene tubing material.

Specific requirements for the polyethylene material are:

The material shall conform to ANSI A21.5 (AWWA C-105). The tubing material shall be made from virgin polyethylene extended in the form of a tube and shall have the following characteristics:

Minimum thickness	8 mils
ASTM D1248, Type I, Class C (black)	Grade E-1
Maximum flow index	0.4
Minimum tensile strength	1,200 p.s.i.
Minimum elongation	300%
Dielectric strength (raw material)	Volume resistivity minimum
Dielectric strength (sheet material)	800 V/mil

Tape for field application shall be Polyken #900 or Scotchwrap #50 or equal, at least two (2) inches wide.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. All work to comply with City or Sewer District Standards and Specifications as well as Ten States Standards. In case of a conflict, the more stringent standards shall apply.

B. Provide polyvinyl chloride (PVC) pipe and fittings for sewer lines.

1.02 RELATED SECTIONS

A. Section 33 30 00 - Sewage Collection System.

1.03 SUBMITTALS

A. Comply with Specifications.

1.04 REFERENCES

A. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly(Vinyl Chloride)(CPVC) Compounds.
   2. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.05 STANDARDS, SPECIFICATIONS, AND CODES

A. All sewer materials, systems and installations shall comply with City or Sewer District Standards and Specifications as well as the Ten States Standards for Waste Water Systems.

PART 2 - PRODUCTS

2.01 PIPE

A. PVC gravity sewer pipe, SDR-26 for 6” and larger and SDR-21 for 4” size in compliance with ASTM D1784 and manufactured from virgin PVC compound with a cell classification of 12454-B with gasket joints and integral bell.

B. Pipe and fittings shall be manufactured in the United States. Foreign made products shall be unacceptable.

C. Pipe shall be permanently marked at 5-foot intervals with the following information:
   1. Nominal size.
   2. Material code designation.
   3. Manufacturer's name or trademark and production record code.
   4. ASTM or AWWA certification.
   5. SDR designation.

D. Warranty:
   1. Manufacturer of the pipe shall warrant product for a period of not less than one (1) year.
   2. Forward copies of warranty to the Owner.
   3. Replace defective materials at no extra cost to the Owner.

2.02 JOINTS

A. Buried Pipe: Gasketed slip joint.

B. Comply with ASTM D3139.

2.03 GASKETS

A. As recommended by pipe manufacturer to conform to pipe.

B. Comply with ASTM F477.

PART 3 - EXECUTION

3.01 GENERAL

A. Any connection to sewer main for the purpose of connecting any sewer line or field line to the sewer main, shall use a minimum of Schedule 40, Polyvinyl chloride (PVC) pipe.

B. Rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations.

C. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of installation and final use.

3.02 TESTING

A. Gravity sewer line shall be tested in accordance with Section 33 30 00.

B. Engineer shall observe tests.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Provide smooth interior Corrugated High Density Polyethylene (HDPE) Pipe with silt tight and leak resistant joint.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling.

B. Section 33 42 10 - Storm Utility Drainage Piping.

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
   1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Pipe, 4-inch to 10" diameter.
   2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12-inch to 48-inch diameter.
   3. AASHTO MP7-97 - Standard Specification for Corrugated Polyethylene Pipe, 54-inch to 60-inch diameter.

B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM D2321 - Recommended Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   2. ASTM D3350 - Standard Specification for Polyethylene Pipe and Fittings Materials.
   3. ASTM F477 - Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.04 SUBMITTALS

A. Submit in accordance with Specifications.

B. Submit manufacturer’s certificate of compliance.

PART 2 - PRODUCTS

2.01 PIPE MATERIAL

A. Pipe and fitting material shall be high-density polyethylene meeting ASTM D3350 minimum cell classification 324420C for 4-inch to 10-inch diameters, or 335420C for 12-inch through 60-inch diameters.

2.02 PIPE REQUIREMENTS

A. Pipe manufactured for this specification shall comply with the requirements for test methods, dimension, and markings found in AASHTO M252, AASHTO M294 and/or AASHTO MP7-97. The prescribed sizes of pipe are nominal inside diameters. Pipe sizes shall be no less than 99% of nominal inside diameter and have a nominal length of 20.0 feet.

B. For 4-inch to 10-inch diameters, the pipe supplied shall be smooth Interior and Annular Exterior Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M252, Type S.

C. For 12-inch to 42-inch diameters, the pipe supplied shall be smooth Interior and Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M294, Type S or D.

D. For 48-inch to 60-inch diameters, the pipe supplied shall be smooth Interior and Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO MP7-97, Type S or D.

E. Manning’s "n" value for use in design shall not be less than 0.012.

2.03 FITTINGS

A. Fittings shall conform to AASHTO M252, M294 or MP7-97. Fabricated fittings shall be welded on the interior and exterior at all junctions.

2.04 JOINT PERFORMANCE

A. Pipe shall be joined with bell-and-spigot joints meeting ASHTO M252, M294 or MP7-97. Joints shall provide a silt-tight and leak resistant joint.

B. Pipe joints shall incorporate a gasket meeting the requirements of ASTM F477 to form a silt tight and leak resistant connection. Joints shall exceed the soil tight joint performance criterial of AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.

C. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris.

D. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

2.05 ACCEPTABLE MANUFACTURERS

A. Smooth Interior and Corrugated HDPE Pipe shall be as manufactured by:
   1. Hancor, Inc.
   2. Advanced Drainage Systems, Inc.
   3. Engineer approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with ASTM D2321 with the exception that minimum cover in trafficked areas shall be one foot for 4-inch to 48-inch pipe and 24-inches for 54-inch and 60-inch pipe.

B. Backfill the pipe with material meeting the requirements of ASTM D2321 Class I, II or III subject to approval of the Engineer. Backfill shall be placed in six to 12 inch lifts compacted to a minimum 90% standard proctor or as designated by the Engineer.

C. Trench width should be wide enough to place and compact backfill around the entire pipe. The trench width shall be outside diameter +24-inches for pipe sizes 12-inch to 30-inch, and outside diameter +36-inches for pipe sizes 36-inches to 60-inches.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Construct manholes.

B. Manhole details are shown on Drawings.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 31 00 00 - Earthwork.

C. Section 31 23 33 - Trenching and Backfilling.

1.03 REFERENCES

A. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
   1. ASTM A615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   2. ASTM C94 - Specification for Ready-Mix Concrete.

PART 2 - MATERIALS

2.01 BASE ROCK

A. Clean gravel or crushed rock conforming to requirements for fill for foundation stabilization as specified in Section 31 23 33.

2.02 CONCRETE

A. Ready-mixed, conforming to ASTM C94.

B. Compressive field strength for manhole bases: Not less than 3,000 psi at 28 days unless noted otherwise on Drawings.

C. Maximum size of aggregate: 1-1/2 inches.

D. Slump: Between 2 and 4 inches.

2.03 FORMS

A. Exterior exposed surfaces shall be plywood, steel, or fiberglass.

B. Others shall be matched boards, plywood, or other approved material.

C. Form vertical surfaces.

D. Trench walls, large rock, or earth shall not be approved form material.

2.04 REINFORCING STEEL

A. Conform to ASTM A 615, Grade 60, deformed bars.

2.05 CAST-IN-PLACE MANHOLES

A. Cast-in-place type manholes shall be in accordance with details of construction approved by Engineer and Section 03 30 00.

B. Precast Manholes:
   1. Submit manufacturer's design and data literature for review and approval to Engineer.
   2. Acceptable Manufacturer: Peterson Concrete Tanks, Jonesboro Concrete Pipe.

2.06 MANHOLE STEPS

A. Cast iron or steel encased in PVC and conform to OSHA requirements.

B. Rungs: Neenah Catalog No. R-1982-J or equal, as shown on Drawings.

C. Space rungs vertically as shown on Drawings.

D. Maximum spacing of rungs: 16 inches.

E. Install steps to provide a continuous ladder with steps equally spaced vertically in assembled manhole.

F. Steps shall be capable of withstanding a force of 350 pounds, applied at any place on the step and in any direction which projects from the point of application through a diameter of the step cross-section at that point, with no permanent deformation resulting.

G. Steps shall be cast into manhole wall.

2.07 MANHOLE FRAMES AND COVERS

A. Manufacturer: Neenah, Model R-1773, or equal.

B. Lettering on Lid for sanitary sewer: "Sanitary Sewer."

PART 3 - EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Conform to applicable portions of Section 31 00 00.

B. Backfill around manholes shall be of same quality as trench backfill immediately adjacent, see Section 31 23 33.

3.02 ROCK BASE

A. Remove water from the excavation.

B. Place a minimum of 6 inches of granular foundation stabilization as specified in Section 31 23 33.

C. Thoroughly compact with mechanical vibrating or power tamper.

3.03 MANHOLE INVERT

A. Grout invert to allow for a smooth transition from one pipe to another.

3.04 MANHOLE FRAMES AND COVERS

A. Install frames and covers on top of manholes to prevent infiltration of surface or groundwater into manholes.

B. Set frames in bed of mortar with mortar carried over flange of ring as shown on Drawings.

C. Set frames so tops of covers are 6 inches above surface of adjoining ground surface, unless otherwise shown or directed.

3.05 HYDROSTATIC TESTING

A. When, in Engineer's opinion, groundwater table is too low to permit visual detection of leaks, hydrostatically test manholes.

B. Test:
   1. Plug all inlets and outlets, and fill manhole with water to base of cover ring.
   2. Leakage in each manhole shall not exceed the allowable rate listed in the below table for the manhole depth given. The rates are based on an allowable leakage rate of 100 gallons/inch diameter/mile/day for a 48 inch diameter manhole.

C. Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into walls.

D. Repair manholes that do not meet leakage test, or are unsatisfactory from visual inspection, to conform to requirements of this Section.

ALLOWABLE LEAKAGE RATES FOR HYDROSTATIC TESTING FOR MANHOLES

Manhole Depth, ft.	Allowable Leakage, gal./hr.
3	0.23
4	0.30
5	0.38
6	0.45
7	0.53
8	0.61
9	0.68
10	0.76
11	0.83
12	0.91
13	0.98
14	1.06
15	1.14
16	1.21
17	1.29
18	1.36
19	1.44
20	1.52
21	1.59
22	1.67
23	1.74
24	1.82

Manhole Depth, ft.	Allowable Leakage, gal./hr.
25	1.89
26	1.97
27	2.05
28	2.12

3.06 VACUUM TESTING

A. Plug lift holes with an approved non-shrink grout.

B. Plug pipe entering manholes, take care to securely brace plug from being drawn into the manhole.

C. Place test head inside top of cone section and inflate seal in accordance with manufacturer's recommendations.

D. Draw a vacuum of 10 inches of mercury and shut pump off. With valves shut, measure the time for the vacuum to drop to 9 inches. Test is satisfactory if the time meets or exceeds the values given in the following table.

E. If manhole fails initial test, make necessary repairs with non-shrink grout while the vacuum is still being drawn. Retest until a satisfactory test is obtained.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS									
Depth (ft)	**Diameter, Inches**								
	30	**33**	**36**	**42**	**48**	**54**	**60**	**66**	**72**
	Time(s)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Disinfection of potable water distribution system.

B. Test and report results.

1.02 RELATED WORK

A. Section 33 05 19 - Ductile Iron Utility Water Pipe.

B. Section 33 14 16 - Manually Operated Valves.

1.03 SUBMITTALS

A. Submit testing procedures in accordance with specifications.

1.04 REFERENCES

A. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
   1. AWWA C651- Standard for Disinfecting Water Mains (or latest edition).

1.05 QUALITY ASSURANCE

A. Testing Laboratory: Arkansas Department of Health.

1.06 REGULATORY REQUIREMENTS

A. Conform to Arkansas Department of Health regulations for Work of this Section.

1.07 PROJECT RECORD DOCUMENTS

A. Submit 3 copies of reports in accordance with specifications.

B. Disinfection report; accurately record:
   1. Type and quantity of disinfectant used.
   2. Date and time of start and completion of disinfectant injection.
   3. Test locations.
   4. Initial, 24-hour, and 48-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
   5. Date and time of start and completion of flushing.
   6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report; accurately record:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certification that water conforms, or fails to conform, to bacterial standards of Arkansas Department of Health.
   8. Bacteriologist's signature.

1.08 STORAGE AND HANDLING

A. The Contractor is reminded that chlorine is a powerful oxidant and reacts readily with foreign substances.

B. Chlorine compounds shall be handled and stored in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 CALCIUM HYPOCHLORITE

A. Granular form containing 65 percent available chlorine by weight.

B. Calcium hypochlrite intended for swimming pool disinfection is **not allowed**.

2.02 SODIUM HYPOCHLORITE

A. Liquid form containing approximately 5 to 15 percent available chlorine.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Perform scheduling and disinfection activity with startup, testing, adjusting, and balancing, and demonstration procedures, including coordination with related systems.

3.02 EXECUTION

A. Provide and attach equipment required to execute Work of this Section.

B. Utilize fire hydrants as blow-off points when possible.

C. Fire hydrants shall not be used for sample points.

D. Sample points constructed shall be a 3/4 inch or 1 inch copper riser pipe that shall extend adequately above the ground surface.

E. During application of chlorine solution, prevent solution from flowing back into the distribution system.

F. Disinfect piping system by one of the three following methods in accordance with ANSI/AWWA C651 (latest version):
   1. Tablet Method.
   2. Continuous Feed Method.
   3. Slug Method.

G. Tablet Method:
   1. This method may only be used if pipes and appurtenances are kept clean and dry during construction.
   2. This procedure must not be used on solvent welded plastic or on screw joint steel pipe.
   3. If using granules:
      a. Placement of calcium hypochlorite granules during construction: Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft (150-m) intervals. The quantity of granules at each location shall be as shown in Table 1.

Weight of calcium hypochlorite granules to be placed at beginning of main and at each 500-ft (150-m) interval

Pipe Diameter (*d*)			**Calcium Hypochlorite Granules**
in	***(mm)***	***oz***	***(g)***
4	(100)	1.7	(48)
6	(150)	3.8	(108)
8	(200)	6.7	(190)
10	(250)	10.5	(298)
12	(300)	15.1	(428)
14 and larger	(350 and larger)	D^2 x 15.1	D^2 x 428

Where D is the inside pipe diameter, in feet D = *d*/12

   4. If using tablets:
      a. Placement of calcium hypochlorite tablets during construction: Calcium hupochlorite tablets (5-grams) shall be placed in the upstream end of each section of pipe to be disinfected, including branch lines. Also, at least one tablet shall be placed in each hydrant branch and in other appurtenances. The number of 5-g tablets required for each pipe section shall be 0.0012 d^2L rounded to the next higher integer, where *d* is the inside pipe diameter, in inches, and *L* is the length of the pipe section, in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe. Calcium hypochlorite tablets shall be attached by an adhesive meeting the

requirements of NSF/ANSI 61. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main. If the tablets are attached before the pipe section is placed in the trench, their positions shall be marked on the pipe exterior to indicate that the pipe has be installed with the tablets at the top.

Number of 5-g calcium hypochlorite tablets required for dose of 25 mg/L*

		Length of Pipe Section, ft (m)				
Pipe Diameter		**13 (4.0) or less**	**18 (5.5)**	**20 (6.1)**	**30 (9.1)**	**40 (12.2)**
in	**(mm)**	**Number of 5-g Calcium Hypochlorite Tablets**				
4	(100)	1	1	1	1	1
6	(150)	1	1	1	2	2
8	(200)	1	2	2	3	4
10	(250)	2	3	3	4	5
12	(300)	3	4	4	6	7
16	(400)	4	6	7	10	13

*Based on 3.25-g available chlorine per tablet

5. Filling and contact time: When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater than 1 ft/sec (0.3 m/sec). Fill rate must be carefully controlled to ensure tablets do not come loose from pipe. Precautions shall be taken to ensure that air pockets are eliminated. As an optional procedure, if required by the purchaser, water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system.
   The chlorinated water shall remain in the pipe for at least 24 hr. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hr. A detectable free chlorine residual (≥0.2 mg/L) shall be found at each sampling point after the 24- or 48-hr period.
6. Refer to ANSI/AWWA C651 (latest version) for additional detail.

H. Continuous Feed Method:
1. After installation flush water line to remove particulates. Velocity in the water line shall not be less than 3 ft./sec.
2. Fill water line with water dosed with chlorine. Chlorine concentration shall not be less than 25 mg/l free chlorine.
3. Retain chlorinated water in water line for 24 hours. Operate valves and hydrants during this time to disinfect.
4. Chlorine residual in water shall not be less than 10 mg/l at the end of the 24 hour period.
5. Refer to ANSI/AWWA C651 (latest version) for additional detail.

I. Slug Method:
   1. After flushing water line to remove particulates, slowly fill water line with water dosed with a 100 mg/l concentration of chlorine.
   2. Retain chlorinated water in water line for 3 hours.
   3. Measure the free chlorine residual in the water line as it is filled. If dosage drops below 50 mg/l during this time, stop flow and relocate chlorination equipment to the reduced level of where chlorine was detected. As flow is resumed, apply chlorine to restore the free chlorine in the water to not less than 100 mg/l.
   4. Operate valves and hydrants during this time to disinfect.
   5. Refer to ANSI/AWWA C651 (latest version) for additional detail.

J. Final Flushing:
   1. Flush water from water line until chlorine measurements are no higher than the chlorine residual that are found in the existing distribution system.
   2. Inspect environment where the chlorinated water is to be discharged. Add a neutralizing chemical as the chlorinated water is being discharged if area is in threat of environmental damage from the chlorinated water.

K. Bacteriological Tests:
   1. After final flushing and prior to the new water line being connected to the existing distribution system, two sets of acceptable water samples collected from the new water line and taken on consecutive days shall be submitted by the Contractor to the bacteriological laboratory at the Arkansas Department of Health in Little Rock, Arkansas.
   2. Samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater per the American Public Health Association, AWWA, and Water Environment Association (latest edition) and shall show the absence of coliform organisms.
   3. If samples collected are positive, the disinfecting procedures and samples shall be repeated until two consecutive day samples are tested safe.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Provide polyvinyl chloride (PVC) pipe and fittings.

1.02 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfilling.

1.03 REFERENCES

A. Arkansas Department of Health.
   1. ADH: *"Rules and Regulations Pertaining to Public Water Systems, latest Edition."*

B. ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959.
   1. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   2. ASTM D2241 - Specifications for Poly (Vinyl Chloride) (PVC) Pressure - Rated Pipe (SDR Series).
   3. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   4. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
   1. AWWA C110/A21.10-03 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. For Water and Other Liquids.
   2. AWWA C605 - Underground installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
   3. AWWA: *"The Ten States Standards for Water, 2007 Edition or latest version."*

PART 2 - PRODUCTS

2.01 PIPE

A. PVC pressure pipe, Class 200, SDR-21 in compliance with ASTM D1784 and manufactured from virgin PVC compound with a cell classification of 12454-B with gasket joints and integral bell for buried water piping.

B. Pipe and fittings shall be manufactured in the United States. Foreign made products shall be unacceptable.

C. Pipe shall be permanently marked at 5-foot intervals with the following information:
   1. Nominal size.
   2. Material code designation.
   3. Manufacturer's name or trademark and production record code.
   4. ASTM or AWWA certification.
   5. SDR designation.

D. Warranty:
   1. Manufacturer of the pipe shall warrant product for a period of not less than one (1) year.
   2. Forward copies of warranty to the Owner.
   3. Replace defective materials at no extra cost to the Owner.

2.02 JOINTS

A. Buried Pipe: Gasketed slip joint.

B. Comply with ASTM D3139.

2.03 FITTINGS

A. Fittings 4 Inches and Larger: Ductile iron, 350 psi pressure class, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
   1. Flanged Joint: ANSI/AWWA C110/A21.10-03 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
   2. Mechanical Joint: ANSI/AWWA C110/A21.10-03 and ANSI/AWWA C110/A21.11-07.
   3. Flexible Joint: American Flex-Lox pipe or equal.

B. Cement Linings: In accordance with ANSI A21.4.

C. Fittings shall receive an exterior coating of 1 mil thick bituminous material in accordance with ANSI A21.4.

D. Fittings shall have distinctly cast on them the manufacturer's identification, pressure rating, nominal diameter of openings, and the number of degrees or fraction of the circle on bends.

E. Fittings Smaller Than 4 Inches: PVC.

2.04 GASKETS

A. As recommended by pipe manufacturer to conform to pipe.

B. Comply with ASTM F477.

2.05 MARKING TAPE

A. Install on pressure systems.

B. Terra Tape "Extra Stretch."

C. Or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Any connection to water main for the purpose of connecting any water line to the water main, shall use a minimum of Schedule 40, Polyvinyl chloride (PVC) pipe.

B. Rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations.

C. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of installation and final use.

3.02 TRACE WIRE

A. Furnish and install a 14-gage insulated copper trace wire with PVC pressure pipe.

B. Run wire continuous from valve box to valve box, meter box, air release vault, cleanout, or other access points.

C. Bring wire up inside boxes and vaults in an accessible method.

D. Bring wire around or tape wire to each pipe section.

E. Pipe testing shall include following trace wire.

F. Wire breaks shall be repaired at no additional expense to the Owner.

3.03 MARKING TAPE

A. On pressure installations of non-metallic pipe, metallic marking tape, Terra Tape Extra Stretch or equal shall be installed 6 to 12 inches above the top of pipe or service line.

B. The tape shall be in addition to the trace wire specified.

3.04 THRUST BLOCKS

A. Install 2,500 psi concrete thrust blocks at bends, wyes, or other thrust points on pressure piping.

B. Block to bear against undisturbed soil and shall be of size and with bearing area as shown on Drawings.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. All work to comply with City Specifications as well as Ten States Standards. In case of a conflict, the more stringent standards shall apply.

B. Furnish and install manually operated valves.

1.02 SUBMITTALS

A. Comply with specifications.

1.03 REFERENCES

A. American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.
   1. AWWA C500 - Gate Valves for Water and Sewerage Systems.
   2. AWWA C509 - Resilient-Seated Gate Valves for Water and Sewage Systems.

B. American Society for Testing and Materials, 1961 Race Street, Philadelphia, Pennsylvania 19103.
   1. ASTM A126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. ASTM B61 - Specification for Steam of Valve Bronze Castings.

PART 2 - MATERIALS

2.01 GENERAL

A. Items specified shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's services.

B. Valves to be complete with necessary operators, valve boxes, extension stems, floor stands, worm and gear operators, operating nuts, etc., required for proper completion of work.

C. Valves of equal quality by other manufacturers will be considered in accordance with the General Conditions.

D. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service.

E. Units shall have name of manufacturer and size of valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

2.02 DESIGN FEATURES

A. Brass and bronze components of valves and appurtenances which have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.

B. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.

C. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.03 VALVE OPERATORS

A. Open by turning counterclockwise.

B. Worm and gear operators to be of totally enclosed design, so proportioned as to permit operation of the valve under full operating head with a maximum pull of 40 pounds on the operator.

C. Self-locking type to prevent the disc or plug from creeping.

D. Self-locking worm gears to be a one-piece design of gear bronze material, accurately machine cut.

E. Worm to be hardened alloy steel with thread ground and polished.

F. Reduction gearing to run in a proper lubricant.

G. Provide gear operators with position indicators, where specified, to show the position of the valve disc or plug.

H. Operators to be galvanized and painted the same color as the valve and associated pipeline.

I. Buried valves to have 2-inch x 2-inch square operating nut.

J. Above-ground valves to have handwheel operators.

2.04 VALVE BOXES

A. Buffalo two-piece sliding type, cast iron, with 5-1/4-inch shaft of appropriate length for the installation.

B. The word STORM WATER shall be cast into the top of the lid.

C. Extension pieces, if required, shall be the manufacturer's standard type.

D. Manufacturers: Mueller H-10364, Clow Corporation F-2452, or equal.

E. Furnish units complete with all necessary bases and accessories.

2.05 EXTENSION STEMS FOR VALVE OPERATORS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover.

B. Constructed of steel.

C. Complete with 2-inch square operating nut.

D. Bolt to valve stem to prevent separation.

2.06 GATE VALVES

A. Acceptable Manufacturers:
   1. Mueller, Model No. A-2360.
   2. American Flow Control, Product Series 500.
   3. Or approved equal.

B. Gate Valves:
   1. Resilient seat type in accordance with AWWA C509 with resilient wedge.
   2. Mechanical joint with non-rising stems and two inch square operating nut.
   3. Open by turning to the left or counter clockwise.

C. Gate Valve Body and Bonnet:
   1. Cast iron.
   2. Conform to ASTM A126, Class B.
   3. "O" ring type seals and smooth unobstructed waterway when in fully open position.
   4. Mechanical joint ends underground; flange joint ends above ground.

PART 3 - EXECUTION

3.01 GENERAL

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run.

B. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned.

C. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly.

D. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten or reinstall the nuts and bolts, and retest the joints.

E. Joints shall be watertight at test pressures before acceptance.

F. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods.

G. Apply approved joint compound to threads prior to making joints.

H. Joints shall be watertight at test pressures before acceptance.

3.02 PLACEMENT OF VALVES

A. Buried valves shall be installed with valve boxes in accordance with the details shown on the Drawings.

B. Buried valves shall have bolts protected by wrapping in polyethylene material.

3.03 ACCESS

A. Location of valves shall be as required to provide accessibility for control and maintenance.

3.04 TESTING

A. Valves: Test at same time adjacent pipeline is tested.

B. Joints shall show no visible leakage under test.

C. Repair joints that show signs of leakage prior to final acceptance.

D. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for damage caused by the testing.

E. Valve manufacturer shall furnish an affidavit stating the materials options furnished comply with these and other referenced Specifications.

3.05 WASTE MANAGEMENT: Divert waste from the landfill in compliance with Construction Waste Management Plan if provided.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. All work to comply with Ten States Standards. In case of a conflict, the more stringent standards shall apply.

B. Provide sewage collection system.

C. Perform pressure and leakage testing of piping.

1.02 RELATED SECTIONS

A. Section 33 05 31.11 – Polyvinyl Chloride Gravity Sewer Pipe.

1.03 SUBMITTALS

A. Comply with Specifications.

1.04 SHOP DRAWINGS

A. Submit specific selection of pipe material and joint type for each pipeline in accordance with Specifications.

1.05 STANDARDS, SPECIFICATIONS, AND CODES

A. All sewer materials, systems and installations shall comply with the Ten States Standards for Waste Water Systems.

PART 2 - PRODUCTS

2.01 GENERAL

A. Unless otherwise specified or shown on Drawings, pipe used for wastewater conveyance shall be ductile iron.

B. Like items of material provided shall be the end products of one manufacturer.

C. To assure uniformity and compatibility of piping components in piping systems, fittings and couplings shall be furnished by the same manufacturer.

2.02 PIPE ENDS FOR BURIED PIPING

A. Use mechanical joint or push-on joint pipe ends for buried pipe.

B. Within limitations noted above, pipe materials and joints do not necessarily have to be the same for all lines in a specific service, except that materials and joints for any particular building, or between any two buildings, or for any particular buried line, shall be the same.

C. No change in material or joint selection will be permitted after submittal of shop drawings and their final review by Engineer.

PART 3 - EXECUTION

3.01 PIPE PREPARATION AND HANDLING

A. Inspect exposed pipe and fittings prior to installing in trench.

B. Inspect interior and exterior protective coating, repair damaged areas in the field with material similar to the original.

C. Clean ends of pipe thoroughly.

D. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

E. Use proper implements, tools, and facilities for the safe and proper protection of the pipe.

F. Avoid any physical damage to the pipe.

G. Do not drop or dump pipe into trenches.

3.02 BELL (JOINT) HOLES

A. At the location of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides where necessary to permit easy visual inspection of the entire joint.

3.03 REMOVAL OF WATER

A. Remove and dispose of water entering the trench during the process of pipe laying.

B. Keep trench dry until pipe laying and jointing are completed.

C. Removal of water shall be in conformance with specifications in Section 31 23 33.

3.04 PREVENT TRENCH WATER AND ANIMALS FROM ENTERING PIPE

A. When pipe laying is not in progress, including noon hours, open ends of pipe shall be closed; and no trench water, animals, or foreign material shall be permitted to enter the pipe.

3.05 PIPE COVER

A. Minimum Pipe Cover: 3 feet unless otherwise indicated.

3.06 LAYING BURIED PIPE

A. Buried pipe shall be prepared as specified and laid on the prepared base and bedded to ensure uniform bearing.

B. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.

C. Joints shall be made as specified for the respective types.

D. Prevent uplift and floating of the pipe prior to backfilling.

3.07 TESTING - GENERAL

A. Conduct pressure and leakage tests on newly installed pipelines.

B. Provide necessary equipment and material and make taps in the pipe, as required.

C. The Engineer will monitor the tests.

3.08 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

A. New pipelines that are to be connected to existing pipelines shall be tested by isolating the new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.

3.09 GRAVITY SEWERS - ALIGNMENT

A. Prior to final acceptance of the Work, the Engineer will test lines for light.

B. Provide assistance to Engineer and lanterns testing.

C. Should any line deviate more than 1/2 inch from a straight line between manholes, the line may be rejected by Engineer.

D. Remove and replace lines rejected by Engineer at no additional cost to Owner.

3.10 GRAVITY SEWERS LEAK TEST

A. Sewers shall pass leakage tests as specified.

B. Leakage test shall be performed in the presence of Owner's representative.

C. Leakage Test by Low Pressure Air Loss:
   1. Plug pipe outlets with suitable test plugs.

2. Brace each plug securely.
3. Pipe air supply to pipeline to be tested so that air supply may be shut off, pressure observed, and air pressure released from the pipe without entering the manhole.
4. A valved branch should be left in the supply line past the shut-off valve terminating in a 1/4-inch female pipe thread for installation of the Owner's test gage.
5. Add air slowly to portion of pipe under test until test gage reads at least 4 psig but less than 5 psig.
6. Shut air supply valve and allow at least 2 minutes for internal pressure to stabilize.
7. Determine time in seconds for pressure to fall .5 psig pressure drop from 3.5 psig to 3.0 psig.
8. Compare observed time with minimum allowable times in the Test Chart for Air Testing at the end of this Section for pass or fail determination.
9. Where ground water level is above the crown of the pipe being tested, test pressure should be increased by 0.4333 psi for each foot the ground water level is above the invert.
10. Do not enter manhole while the line is pressurized.

3.11 MANDREL TEST

A. Perform deflection (reduction in vertical inside diameter) tests between successive manholes on PVC gravity sewer pipe at least 60 days after installation.

B. Perform tests utilizing a sharp edge Mandrel.

C. Deflection shall not exceed 5 percent.

D. Mandrel dimensions based on 5 percent deflection shall be as follows:
1. 6-inch diameter pipe: 5.70-inch Mandrel OD.
2. 8-inch diameter pipe: 7.60-inch Mandrel OD.
3. 10-inch diameter pipe: 9.50-inch Mandrel OD.
4. 12-inch diameter pipe: 11.40-inch Mandrel OD.

3.12 TEST RECORDS

A. Records shall be made of each piping system installation during the test. These records shall include:
1. Date of test.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
6. Certification by Contractor and written approval by Engineer.

3.13 INTERIM CLEANING

A. During fabrication prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other debris within piping sections.

B. Examine pipe to assure removal foreign objects prior to assembly.

C. Shop cleaning may employ using a conventional commercial cleaning method if it does not corrode, deform, swell, or alter the physical properties of the material being cleaned.

3.14 EXTERIOR PROTECTION FOR BURIED OR SUBMERGED PIPING ACCESSORIES

A. Wrap buried, submerged, or embedded mechanical joint fittings and valves with 8 mil polywrap.

TEST CHART FOR AIR TESTING SEWERS LEAKAGE TESTING OF SEWERS BY LOW PRESSURE AIR LOSS -- TIME PRESSURE DROP METHOD
Minimum time in (min:sec) for 0.5 psig drop (3.5 psig to 3.0 psig)

Distance Between Manholes	Nominal Pipe Diameter								
	6	8	10	12	15	18	21	24	36
100	2:50	3:47	4:43	5:40	7:05	8:30	9:55	11:24	12:54
150	2:50	3:47	4:43	5:40	7:05	9:37	13:05	17:57	20:15
200	2:50	3:47	4:43	5:42	8:54	12:49	17:27	22:48	25:43
250	2:50	3:47	4:57	7:08	11:08	16:01	21:49	28:30	32:09
300	2:50	3:48	5:56	8:33	13:21	19:14	26:11	34:11	38:35
350	2:50	4:26	6:55	9:58	15:35	22:26	30:32	39:53	45:09
400	2:51	5:04	7:54	11:24	17:48	25:38	34:54	45:35	51:28
450	3:12	5:42	8:54	12:50	20:02	28:51	39:16	51:17	57:54

END OF SECTION