

**PROJECT MANUAL FOR:**

**A NEW RACKET CENTER & OBSERVATION DECK FOR:**

# **ST JULIEN RECREATIONAL FACILITY**

**701 ST. NAZAIRE ROAD  
BROUSSARD, LA 70518**

**DATE: 1-5-26**

PREPARED BY:



**Louisiana license no. 6509**

**819 SAINT JOHN ST  
LAFAYETTE, LOUISIANA 70501**

**(337) 962-1255 - [russell@trahanarchitecture.com](mailto:russell@trahanarchitecture.com)**

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**ST JULIEN RECREATIONAL FACILITY**

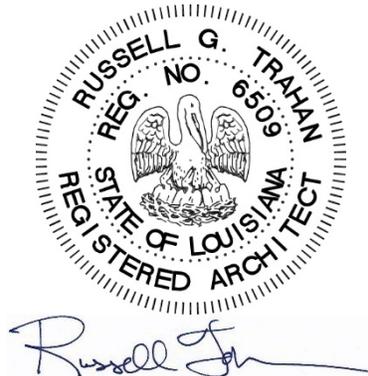
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(337) 962-1255 - [russell@trahanarchitecture.com](mailto:russell@trahanarchitecture.com)**

**The following specifications Divisions were prepared by and under the direct supervisions of the licensed Architect whose seal / stamp appears below:**



A handwritten signature in blue ink that reads 'Russell G. Trahan'.

**SPECIFICATION DIVISIONS:**

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 05 - METALS

(Section 057300 only)

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

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DIVISION 32 - EXTERIOR IMPROVEMENTS (INCLUDES CIVIL DIVISIONS III)

(Section 323113 only)

## ADVERTISEMENT FOR BIDS

Notice is hereby given that sealed bids will be received by the City of Broussard, Lafayette Parish, Louisiana, at Broussard City Hall, 406 E. Madison St, Bldg. A, Broussard, Louisiana 70518, until 2:00 p.m. CST, on March 05, 2025, for:

### **A new racket center & observation deck for: ST JULIEN RECREATIONAL FACILITY**

at which time the bids will be opened and publicly read aloud. Bids received after the specified time will not be considered.

The work shall consist of the following:

New Concession Building, Pro-Shop / Observation Building, Conversion and Expansion of existing Basketball court to new 4 Court Covered Pickleball court area, New 12 Court Pickleball Courts area, Covered, New 10 Court Pickleball Courts area and all site and utility work as indicated in the drawings and in association with the project.

**A Mandatory Pre-Bid Conference will be held at 10:00 a.m. on February 19th, 2026 in the City of Broussard Public Works Building, 102 Bercegeay Road, Broussard, La. All prospective bidders shall be present at the beginning of the pre-bid conference and shall remain in attendance for the duration of the conference. Any prospective bidder who fails to attend the conference or remain for the duration shall be prohibited from submitting a bid for the project.**

Construction Time: **330 calendar days**, exclusive of delays beyond the Contractor's control from the date stipulated in the written Notice to Proceed.

The Contractor shall obtain, maintain during the life of the project, and provide to the Owner copies of the following bonds and policies which shall be obtained from surety companies, licensed to do business in the State of Louisiana, in the amounts and for the purpose stated and subject to the Owner's approval:

1. **BID BOND:** A "Bid Guarantee" equivalent to 5% of the bid price consisting of a firm commitment, such as a bid bond, certified check, or other negotiable instrument, shall accompany each bid as assurance that the bidder will, upon acceptance of his bid, execute such contractual documents as may be required and within the time specified.
2. **PERFORMANCE BOND:** A performance bond of not less than 100% of the contract price shall be executed to assure the Contractor's faithful performance of the contract.
3. **PAYMENT BOND:** A payment bond of not less than 100% of the contract price shall be executed to assure payment as required by law of all persons supplying labor and material in the performance of the work provided by the contract.

All bonds (Bid Bond, Performance Bond and Payment Bond) shall be written by a surety or insurance company which is currently on the U.S. Department of the Treasury Financial Management Service List (Circular Number 570) of approved bonding companies which is published annually in the Federal Register, or by a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A.M. Best's Key Rating Guide to write individual bonds up to ten percent of the policyholders' surplus as shown in the A.M. Best's Key Rating Guide or by an insurance company in good standing licensed to write bonds which is either domiciled in Louisiana or owned by Louisiana residents. The surety or insurance company must be currently licensed to do business in the State of Louisiana.

Only the bids of contractors licensed under Louisiana Contractor's Licensing Law R.S. 37:2150-2164 will be considered for bids exceeding \$50,000.00. Should the bid exceed \$50,000.00, contractors desiring to bid shall submit evidence that they hold license of proper classification ("**Building Construction**" classification required) in full force and effect at the time drawings, specifications and forms are requested from the office of the Engineers. The bidder shall show his license number on the bid and on the sealed envelope in which their bid is enclosed.

The contract documents, consisting of the Notice to Bidders, Information for Bidders, General Conditions, Technical Specifications, Special Conditions, Bid Form and Contract Documents, and any published Addenda, may be examined on all business days at the following locations during the specified hours:

1. Trahan Architecture + Planning, LLC  
Address: 819 Saint John St, Lafayette, LA 70501  
Telephone: 337-504-7580  
Monday- Thursday 8:00am to 4:00pm,  
Friday 8:00am to 11:00am

2. Broussard City Hall  
406 E. Madison St.  
Bldg. A  
Broussard, Louisiana 70518  
Mon-Thur; 6:30 a.m. to 5:00 p.m.

Complete Bid Documents for this project are available in electronic form. They may be obtained without charge and without deposit from Trahan Architecture + Planning, LLC. Bid Documents may also be obtained from [www.centralbidding.com](http://www.centralbidding.com) for a nominal charge or subscription. Printed copies are not available from the Designer, but arrangements can be made to obtain them through most reprographic firms. Plan holders are responsible for their own reproduction costs. Questions about this procedure shall be directed to the Designer at:

Designer Firm Name: Trahan Architecture + Planning, LLC  
Address: 819 Saint John St, Lafayette, LA 70501  
Telephone: 337-504-7580  
Email: russell@trahanarchitecture.com

Bid related information also available on line and bids may also be submitted online at:

<https://www.centralauctionhouse.com/rfpc10684-city-of-broussard.html>

No bidder may withdraw his bid for at least forty five (45) days after the time scheduled for the opening of bids. Each bid shall be submitted only on the Bid Form.

The Owner reserves the right to reject any or all bids for just cause; such actions will be in accordance with La. R.S. 38:2214.

By order of the Mayor and Council of the City of Broussard, Lafayette Parish, Louisiana.

ATTEST:

s/ Ray Bourque  
(Mayor)

Publish Dates:  
January 28, 2026  
February 4, 2026  
February 11, 2026

# INSTRUCTIONS TO BIDDERS

## COMPLETION TIME:

The Bidder shall agree to fully complete the contract within (330) consecutive calendar days, subject to such extensions as may be granted under Paragraph 8.3, in the General Conditions and the Supplementary Conditions, and acknowledges that this construction time will start on or before the date specified in the written “Notice to Proceed” from the Owner.

## LIQUIDATED DAMAGES:

The Bidder shall agree to pay as Liquidated Damages the amount of Four Thousand Dollars (\$4,000.00) for each consecutive calendar day for which the work is not complete, beginning with the first day beyond the contract completion date stated on the “Notice to Proceed” or as amended by change order.

## TAX EXEMPTION:

The project is to be exempt from sales and use taxes imposed by any taxing authority. The successful contractor / subcontractors will be required to submit the appropriate tax exemption form To apply for Louisiana tax exemption, contractors must have a LaTAP account and be registered for Sales Tax in order to submit the application. The Form R-85012 application can now only be filed electronically through Louisiana Taxpayer Access Point (LaTAP). The following is information to include on the form for the project:

Public Entity: Facility Planning and Control

LDR Sales Tax Account #: N/A

## ARTICLE 1 DEFINITIONS

1.1 The Bid Documents shall include the following:

- Advertisement for Bids
- Instructions to Bidders
- Bid Form
- Bid Bond Form
- General Conditions of the Contract for Construction, AIA Document A201, 2017 Edition
- Supplementary Conditions
- Contract Between Owner and Contractor and Performance and Payment Bond and Non-Collusion Affidavit
- Attestations Affidavit – 10 day document
- User Documents (if applicable)
- Other Documents (if applicable)
- Specifications & Drawings
- Addenda issued during the bid period to be acknowledged on the Bid Form

1.2 All definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201 and the Supplementary Conditions are applicable to the Bid Documents.

1.3 Addenda are written and/or graphic instruments issued by the Architect prior to the opening of bids,

which modify or interpret the Bid Documents by additions, deletions, clarifications, corrections and prior approvals.

1.4 A bid is a complete and properly signed proposal to do the work or designated portion thereof for the sums stipulated therein supported by data called for by the Bid Documents.

1.5 Base bid is the sum stated in the bid for which the Bidder offers to perform the work described as the base, to which work may be added, or deleted for sums stated in alternate bids.

1.6 An alternate bid (or alternate) is an amount stated in the bid to be added to the amount of the base bid if the corresponding change in project scope or materials or methods of construction described in the Bid Documents is accepted.

1.7 A Bidder is one who submits a bid for a prime Contract with the Owner for the work described in the Bid Documents.

1.8 A Sub-bidder is one who submits a bid to a Bidder for materials and/or labor for a portion of the work.

1.9 Where the word "Architect" is used in any of the documents, it shall refer to the Architect of record of the project, regardless of discipline.

## ARTICLE 2

### PRE-BID CONFERENCE

2.1 A Pre-Bid Conference shall be held at least 10 days before the date for receipt for bids. The Architect shall coordinate the setting of the date, time and place for the Pre-Bid Conference with the User and shall notify, in writing, the Owner and all who have received sets of the Bid Documents to attend. The purpose of the Pre-Bid Conference is to familiarize Bidders with the requirements of the Project and the intent of the Bid Documents, and to receive comments and information from interested Bidders. If the Pre-Bid Conference is stated in the Advertisement for Bids to be a Mandatory Pre-Bid Conference, bids shall be accepted only from those Bidders who attend the Pre-Bid Conference. Bidders who are not in attendance for the **entire** Pre-Bid Conference will be considered to have not attended.

2.2 Any revision of the Bid Documents made as a result of the Pre-Bid Conference shall not be valid unless included in an addendum.

## ARTICLE 3

### BIDDER'S REPRESENTATION

3.1 Each Bidder by making his bid represents that:

3.1.1 He has read and understands the Bid Documents and his bid is made in accordance therewith.

3.1.2 He has visited the site and has familiarized himself with the local conditions under which the work is to be performed.

3.1.3 His bid is based solely upon the materials, systems and equipment described in the Bid Documents, as advertised and as modified by addenda.

3.1.4 His bid is not based on any verbal instructions contrary to the Bid Documents and addenda.

3.1.5 He is familiar with Code of Governmental Ethics requirement that prohibits public servants and/or their immediate family members from bidding on or entering into contracts; he is aware that the Architect and its principal owners are considered Public Servants under the Code of Governmental Ethics for the limited purposes and scope of the Design Contract with the State on this Project (see Ethics Board Advisory Opinion, No. [2009-378](#) and [2010-128](#)); and neither he nor any principal of the Bidder with a controlling interest therein has an immediate family relationship with the Architect or any principal within the Architect's firm (see [La. R.S. 42:1113](#)). Any Bidder submitting a bid in violation of this clause shall be disqualified and any contract entered into in violation of this clause shall be null and void.

3.2 The Bidder must be fully qualified under any State or local licensing law for Contractors in effect at the time and at the location of the work before submitting his bid. In the [State of Louisiana, Revised Statutes 37:2150, et seq.](#) will be considered, if applicable.

The Bidder shall be responsible for determining that all of his Sub-bidders or prospective Subcontractors are duly licensed in accordance with law.

## ARTICLE 4

### BID DOCUMENTS

4.1 Copies

4.1.1 The Architect shall provide the Bid Documents in electronic format. They may be obtained without charge and without deposit as stated in the Advertisement for Bids.

4.1.2 Printed copies will not be available from the Architect, but arrangements can be made to obtain them through most reprographic firms and/or plan rooms. All plan holders are responsible for their own reproduction costs.

4.1.3 Complete sets of Bid Documents shall be used in preparing bids; neither the Owner nor the Architect assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.

4.1.4 The Owner or Architect in making the Bid Documents available on the above terms, do so only for the purpose of obtaining bids on the work and do not confer a license or grant for any other use.

#### 4.2 Interpretation or Correction of Bid Documents

4.2.1 Bidders shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Bid Documents or of the site and local conditions.

4.2.2 Bidders requiring clarification or interpretation of the Bid Documents shall make a written request to the Architect, at least seven days prior to the date for receipt of bids.

4.2.3 Any interpretation, correction or change to the Bid Documents will be made by addendum. Interpretations, corrections or changes to the Bid Documents made in any other manner will not be binding and Bidders shall not rely upon such interpretations, corrections and changes.

#### 4.3 Substitutions

4.3.1 The materials, products and equipment described in the Bid Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. All substitutions shall be in accordance with [La. R.S. 38:2212\(T\)\(2\)](#).

4.3.2 For closed specifications, when a potential supplier submits a particular product for prior approval other than a product specified in the Bid Documents, said product will not be considered unless written request for approval has been submitted by the Bidder and has been received by the Architect at least fourteen (14) working days prior to the opening of bids. ([La. R.S. 38:2295\(C\)](#)) Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution, including model numbers, drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitution would require shall be included. It shall be the responsibility of the Bidder to include in his bid all changes required of the Bid Documents if the proposed product is used.

Prior approval, if given, is contingent upon supplier being responsible for any costs which may be necessary to modify the space or facilities needed to accommodate the materials and equipment approved.

4.3.3 If the Architect approves any proposed substitution, such approval shall be set forth in an addendum. Bidders shall not rely upon approvals made in any other manner.

#### 4.4 Addenda

4.4.1 Addenda will be transmitted to all who are known by the Architect to have requested and/or received a complete set of Bid Documents.

4.4.2 Copies of addenda will be made available for inspection wherever Bid Documents are on file for that purpose.

4.4.3 In accordance with [La. R.S. 38:2212\(O\)\(2\)\(b\)](#) addenda shall not be issued within a period of seventy-two (72) hours prior to the advertised time for the opening of bids, excluding Saturdays, Sundays, and any other legal holidays. If the necessity arises of issuing an addendum modifying plans and specifications within the seventy-two (72) hour period prior to the advertised time for the opening of bids, then the opening of bids shall be extended at least seven but no more than twenty-one (21) working days, without the requirement of re-advertising. The Owner shall be consulted prior to issuance of such an addendum and shall approve such issuance. The revised time and date for the opening of bids shall be stated in the addendum.

4.4.4 Each Bidder shall ascertain from the Architect prior to submitting his bid that he has received all addenda issued, and he shall acknowledge their receipt on the Bid Form.

4.4.5 The Owner shall have the right to extend the bid date by up to (30) thirty days without the requirement of re-advertising. Any such extension shall be made by addendum issued by the Architect.

## ARTICLE 5

### BID PROCEDURE

#### 5.1 Form and Style of Bids

5.1.1 Bids shall be submitted on the Louisiana Uniform Public Work Bid Form provided by the Architect for this project.

5.1.2 The Bidder shall ensure that all applicable blanks on the Bid Form are completely and accurately filled in.

5.1.3 Bid sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written words shall govern.

5.1.4 Any interlineation, alteration or erasure must be initialed by the signer of the bid or his authorized representative.

5.1.5 Bidders are cautioned to complete all alternates should such be required in the Bid Form. Failure to submit alternate prices will render the bid non responsive and shall cause its rejection.

5.1.6 Bidders are cautioned to complete all unit prices should such be required in the Bid Form. Unit prices represent a price proposal to do a specified quantity and quality of work. Unit prices are incorporated into the base bid or alternates, as indicated on the Unit Price Form, but are not the sole components thereof.

5.1.7 Bidder shall make no additional stipulations on the Bid Form nor qualify his bid in any other manner.

5.1.8 Written evidence of the authority of the person signing the bid for the public work shall be submitted in accordance with [La. R.S. 38:2212\(B\)\(5\)](#).

5.1.9 On any bid in excess of fifty thousand dollars (\$50,000.00), the Bidder shall certify that he is licensed under [La. R.S. 37: 2150-2173](#) and show his license number on the bid above his signature or his duly authorized representative.

## 5.2 Bid Security

5.2.1 No bid shall be considered or accepted unless the bid is accompanied by bid security in an amount of five percent (5.0%) of the base bid and all alternates.

The bid security shall be in the form of a certified check or cashier's check drawn on a bank insured by the Federal Deposit Insurance Corporation, or a Bid Bond written by a surety company licensed to do business in Louisiana and signed by the surety's agent or attorney-in-fact. The Bid Bond shall include the legal name of the Bidder, be in favor of the owner, City of Broussard, and shall be accompanied by appropriate power of attorney. The Bid Bond must be signed by both the Bidder/principal and the surety in the space provided on the Bid Bond Form. Failure by the Bidder/principal or the surety to sign the Bid Bond shall result in the rejection of the bid.

Bid security furnished by the Bidder shall guarantee that the Bidder will, if awarded the work according to the terms of his proposal, enter into the Contract and furnish Performance and Payment Bonds as required by these Bid Documents, within fifteen (15) days after written notice that the instrument is ready for his signature.

Should the Bidder refuse to enter into such Contract or fail to furnish such bonds, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as penalty.

5.2.2 The Owner will have the right to retain the bid security of Bidders until either (a) the Contract has been executed and bonds have been furnished, or (b) the specified time has elapsed so that bids may be withdrawn, or (c) all bids have been rejected.

## 5.3 Submission of Bids

5.3.1 The bid shall be sealed in an opaque envelope. The bid envelope shall be identified on the outside with the name of the project, and the name, address, and license number of the Bidder.

The envelope shall not contain multiple bid forms, and will be received until the time specified and at the place specified in the Advertisement for Bids. It shall be the specific responsibility of the Bidder to deliver his sealed bid to the designated location at the appointed place and prior to the announced time for the opening of bids. Late delivery of a bid for any reason, including late delivery by United States Mail, express delivery, or misdirection by any party, shall disqualify the bid.

If the bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "Bid Enclosed" on the face thereof. Such

bids shall be sent by Registered or Certified Mail, Return Receipt Requested, addressed to:

**TO: City of Broussard, City Hall**

Attn: Assistant Clerk/Deputy Clerk/City Clerk

406 E. Madison St.

Bldg. A

Broussard, LA 70518

5.3.2 Bids shall be deposited at the designated location prior to the time on the date for receipt of bids indicated in the Advertisement for Bids, or any extension thereof made by addendum. Bids received after the time and date for receipt of bids will be returned unopened.

5.3.3 Bidder shall assume full responsibility for timely delivery at location designated for receipt of bids.

5.3.4 Oral, telephonic or telegraphic bids are invalid and shall not receive consideration. Owner shall not consider notations written on outside of bid envelope which have the effect of amending the bid. Written modifications enclosed in the bid envelope, and signed or initialed by the Contractor or his representative, shall be accepted.

#### 5.4 Modification or Withdrawal of Bid

5.4.1 A bid may not be modified, withdrawn or canceled by the Bidder during the time stipulated in the Advertisement for Bids, for the period following the time and bid date designated for the receipt of bids, and Bidder so agrees in submitting his bid, except in accordance with **La. R.S. 38:2214** which states, in part, "Bids containing patently obvious, unintentional, and substantial mechanical, clerical, or mathematical errors, or errors of unintentional omission of a substantial quantity of work, labor, material, or services made directly in the compilation of the bid, may be withdrawn by the contractor if clear and convincing sworn, written evidence of such errors is furnished to the public entity within forty-eight hours of the bid opening excluding Saturdays, Sundays, and legal holidays".

5.4.2 Prior to the time and date designated for receipt of bids, bids submitted early may be modified or withdrawn only by notice to the party receiving bids at the place and prior to the time designated for receipt of bids.

5.4.3 Withdrawn bids may be resubmitted up to the time designated for the receipt of bids provided that they are then fully in conformance with these Instructions to Bidders.

5.4.4 Bid Security shall be in an amount sufficient for the bid as modified or resubmitted.

#### 5.5 Prohibition of Discriminatory Boycotts of Israel

By submitting a bid, the Bidder certifies and agrees that the following information is correct:

In preparing its bid, the Bidder has considered all proposals submitted from qualified, potential subcontractors and suppliers, and has not, in the solicitation, selection, or commercial treatment of any subcontractor or supplier, refused to transact or terminated business activities, or taken other actions intended to limit commercial relations, with a person or entity that is engaging in commercial transactions in Israel or Israel-controlled territories, with the specific intent to accomplish a boycott or divestment of Israel. The Bidder has also not retaliated against any person or other entity for reporting such refusal, termination, or commercially limiting actions. The state reserves the right to reject any bid if this certification is subsequently determined to be false and to terminate any contract awarded based on such a false response.

## ARTICLE 6

### CONSIDERATION OF BIDS

#### 6.1 Opening of Bids

6.1.1 The properly identified Bids received on time will be opened publicly and will be read aloud, and a tabulation abstract of the amounts of the base bids and alternates, if any, will be made available to Bidders after bid opening by emailing a request to the Architect.

#### 6.2 Rejection of Bids

6.2.1 The Owner shall have the right to reject any or all bids and in particular to reject a bid not accompanied by any required bid security or data required by the Bid Documents or a bid in any way incomplete or irregular.

### 6.3 Acceptance of Bid

6.3.1 It is the intent of the Owner, if he accepts any alternates, to accept them in the order in which they are listed in the Bid Form. Determination of the Low Bidder shall be on the basis of the sum of the base bid and the alternates accepted. However, the Owner shall reserve the right to accept alternates in any order which does not affect determination of the Low Bidder.

## ARTICLE 7

### POST-BID INFORMATION

#### 7.1 Submissions

7.1.1 At the Pre-Construction Conference, the Contractor shall submit the following information to the Architect.

7.1.1.1 A designation of the work to be performed by the Contractor with his own forces.

7.1.1.2 A breakdown of the Contract cost attributable to each item listed in the Schedule of Values Form. No payments will be made to the Contractor until this is received.

7.1.1.3 The proprietary names and the suppliers of principal items or systems of material and equipment proposed for the work.

7.1.1.4 A list of names and business domiciles of all Subcontractors, manufacturers, suppliers or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the work. It is the preference of the Owner that, to the greatest extent possible or practical, the Contractor utilize Louisiana Subcontractors, manufacturers, suppliers and labor.

7.1.2 The General Contractor shall be responsible for actions or inactions of Subcontractors and/or material suppliers.

The General Contractor is totally responsible for any lost time or extra expense incurred due to a Subcontractor's or Material Supplier's failure to perform. Failure to perform includes, but is not limited to, a Subcontractor's financial failure, abandonment of the project, failure to make prompt

delivery, or failure to do work up to standard. Under no circumstances shall the Owner mitigate the General Contractor's losses or reimburse the General Contractor for losses caused by these events.

7.1.3 The lowest responsive and responsible Bidder shall submit to the Architect and the Owner within ten days after the bid opening a letter/letters from the manufacturer stating that the manufacturer will issue the roof system guarantee complying with the requirements based on the specified roof system and include the name of the applicator acceptable to the manufacturer at the highest level of certification for installing the specified roof system. This manufacturer shall be one that has received prior approval or is named in the specifications.

In accordance with La. [R.S. 38:2227](#) [references La. R.S. 38:2212(A)(3)(c)(ii), which has since been renumbered as [La. R.S. 38:2212\(B\)\(3\)\(a\)](#)], La. R.S. [38:2212.10](#) and [La. R.S. 23:1726\(B\)](#) the apparent low Bidder on this project shall submit the completed Attestations Affidavit (Past Criminal Convictions of Bidders, Verification of Employees and Certification Regarding Unpaid Workers Compensation Insurance) form found within this bid package to the Architect within 10 days after the opening of bids. The Attestations Affidavit may also be submitted in the bid envelope.

## ARTICLE 8

### PERFORMANCE AND PAYMENT BOND

#### 8.1 Bond Required

8.1.1 The Contractor shall furnish and pay for a Performance and Payment Bond written by a company licensed to do business in Louisiana, which shall be signed by the surety's agent or attorney-in-fact, in an amount equal to 100% of the Contract amount. Surety must be listed currently on the U. S. Department of Treasury Financial Management Service List (Treasury List) as approved for an amount equal to or greater than the contract amount, or must be an insurance company domiciled in Louisiana or owned by Louisiana residents. If surety is qualified other than by listing on the Treasury list, the contract amount may not exceed fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance and

may not exceed the amount of \$500,000. However, a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A. M. Best's Key Rating Guide shall not be subject to the \$500,000 limitation, provided that the contract amount does not exceed ten percent of policyholders' surplus as shown in the latest A. M. Best's Key Rating Guide nor fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance. The Bond shall be signed by the surety's agent or attorney-in-fact. The Bond shall be in favor of the Owner, the City of Broussard.

## 8.2 Time of Delivery and Form of Bond

8.2.1 The Contractor shall deliver the required bond to the Owner simultaneous with the execution of the Contract.

8.2.2 Bond shall be in the form furnished in the Bid Documents, Entitled Contract Between Owner And Contractor And Performance And Payment Bond, a copy of which is included in the Bid Documents.

8.2.3 The Contractor shall require the Attorney-in-Fact who executes the required bond on behalf of the surety to affix thereto a certified and current copy of his power of Attorney.

## ARTICLE 9

## FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

### 9.1 Form to be Used

9.1.1 Form of the Contract to be used shall be furnished by the Architect, an example of which is bound in the Bid Documents.

### 9.2 Award

9.2.1 After award of the Contract and prior to Contract execution, the successful Bidder, if a corporation, shall have on file with the Louisiana Secretary of State, a Disclosure of Ownership Affidavit, in accordance with [La. R.S. 12:1-1622](#), [12:205\(C\)](#) and [12:304\(A\)\(11\)](#).

9.2.2 In accordance with Louisiana Law, when the Contract is awarded, the successful Bidder shall, at the time of the signing of the Contract, execute the Non-Collusion Affidavit included in the Contract Documents

9.2.3 When this project is financed either partially or entirely with State Bonds, the award of this Contract is contingent upon the sale of bonds by the State Bond Commission. The State shall incur no obligation to the Contractor until the Contract Between Owner and Contractor is duly executed.

## **IMPORTANT NOTICE REGARDING CORPORATE RESOLUTION**

**A CORPORATE RESOLUTION OR WRITTEN EVIDENCE OF AUTHORITY AUTHORIZING THE PERSON SIGNING THE BID MUST BE SUBMITTED WITH YOUR BID PURSUANT TO LA. R.S.38:2212 B(5). THIS RESOLUTION OR WRITTEN EVIDENCE OF AUTHORITY MUST BE SIGNED BY AN OFFICER WHO IS CURRENTLY LISTED WITH THE SECRETARY OF STATE. THE AUTHORITY OF THE SIGNATURE OF THE PERSON SUBMITTING THE BID SHALL BE DEEMED SUFFICIENT AND ACCEPTABLE IF THE CONDITIONS LISTED IN THE INFORMATION FOR BIDDERS SECTION 2 ARE MET.**

**FAILURE TO SUBMIT THE CORPORATE RESOLUTION OR WRITTEN EVIDENCE OF AUTHORITY WITH YOUR BID SHALL RESULT IN REJECTION OF YOUR BID.**

**NOTE: SECRETARY OF STATE BUSINESS LISTING SHALL NOT BE ACCEPTED AS A CORPORATE RESOLUTION.**

## GENERAL CONDITIONS

1. **AIA document A201-2017 “General Conditions of the Contract for Construction” shall be made part of the Contract Documents in its entirety.**

1.1.1. A copy may be purchased from:

1.1.1.1. Trahan Architecture + Planning, LLC

1.1.1.2. AIA (The American Institute of Architects, <http://www.aia.org>)

# SUPPLEMENTARY CONDITIONS

## ARTICLE 1 EXTENTIONS OF CONTRACT TIME

### 1.1. REQUESTS FOR ADDITIONAL TIME DUE TO ADVERSE WEATHER CONDITIONS

- 1.1.1. A party must make a claim as defined herein within the time limits provided.
- 1.1.2. If adverse weather conditions are the basis for a claim for additional time, the Contractor shall document that weather conditions had an adverse effect on the scheduled construction. An increase in the contract time due to weather shall not be cause for an increase in the contract sum.
- 1.1.3. The following are considered reasonably anticipated days of adverse weather on a monthly basis and shall be accounted for in the total calendar days allowed for the construction schedule:

January	<u>11</u> days	May	<u>5</u> days	September	<u>4</u> days
February	<u>10</u> days	June	<u>6</u> days	October	<u>3</u> days
March	<u>8</u> days	July	<u>6</u> days	November	<u>5</u> days
April	<u>7</u> days	August	<u>5</u> days	December	<u>8</u> days

**1.1.3.1. The Contractor's request for additional time due to adverse weather conditions shall be considered only for days over the allowable number of days stated above. The Contractor shall track and document all adverse weather and the effect upon the schedule of work. This document shall be submitted to the Architect within 1 week of the date of the adverse weather or it will not be considered.**

1.1.4 Clarification: Contract is on a calendar day basis.

### 1.2. RECOGNIZED HOLIDAYS

- 1.2.1. No working days shall be charged for the days listed below.
- (1) New Year's Day - January 1st
  - (2) Martin Luther King Day - 3rd Monday in January
  - (3) Mardi Gras Day
  - (4) Good Friday
  - (5) Memorial Day
  - (6) Independence Day - July 4th
  - (7) Labor Day - 1st Monday in September
  - (8) Thanksgiving Day - 4th Thursday in November
  - (9) Acadian Day - Day after Thanksgiving Day
  - (10) Christmas Day - December 25<sup>th</sup>

### 1.3. REQUESTS FOR ADDITIONAL CONTRACT TIME

- 1.3.1. The Owner reserves the right, at its sole option, and for good cause shown, to grant to the Contractor additional time for completion of the contract. Any and all granting of additional time for completion of the work under the contract must be initiated by

written request from the Contractor to the Architect. For the request to be considered, it must be received by the Architect no later than fourteen (14) calendar days following the time that the event which prompted the request occurs. It is the Contractor's responsibility to include in the written request the specific and detailed reasons that he feels he deserves additional contract days in order to complete the contract.

- 1.3.1.1. No such extension shall be made for delay occurring more than fourteen (14) calendar days before claim is made in writing to the Architect.

## **ARTICLE 2 CHANGES IN THE WORK**

### **2.1. CHANGE ORDERS**

2.1.1. "Cost of the Work" for the purpose of Change Orders shall be the costs incurred in performance of the work and paid by the Contractor and Subcontractors which shall consist of:

1. Wages paid direct labor personnel, delineating a labor burden markup for applicable payroll taxes, worker's compensation insurance, unemployment compensation, and social security taxes.
2. Cost of all materials and supplies, including the identification of each item and its cost.
3. Identify each necessary piece of machinery and equipment and its individual cost.
4. Other documented direct costs.
5. Credit will not be required for overhead and profit.

2.1.2. Before a Change Order is prepared, the Contractor shall provide and deliver to the Architect the following information concerning the Cost of the Work within a reasonable time after being notified to prepare said Change Order:

2.1.2.1. A detailed itemized list of labor, material and equipment costs for the General Contractor's work including quantities and unit costs for each item of labor, material and equipment.

2.1.2.2. An itemized list of labor, material and equipment costs for each Subcontractor's and/or Sub-Subcontractor's work including quantities and unit costs for each item of labor, material, and equipment.

2.1.3. After a Change Order has been approved, no future requests for extensions of time or additional cost shall be considered for that Change Order.

## **ARTICLE 3 SURVEYS, PERMITS, RIGHT OF WAY, EASEMENTS AND REGULATIONS**

### **3.1. SURVEYS**

3.1.1. Refer to "General Conditions" Article 2, 2.2.3 for Owner responsibilities. Using the written legal property descriptions, recorded plat, and/or property surveys provided to him by the Owner, the Contractor shall employ a qualified surveyor to field verify and mark the property limits, locate building corners in relation to those limits, prior to any site work. The Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets. The Contractor will be responsible for maintaining their accuracy thereafter and will be responsible

for all expenses resulting from their disturbance. The Contractor shall notify the Architect in writing at least forty-eight (48) hours in advance of the time the Contractor contemplates commencing work on any parts of the work requiring surveys to be provided by the Owner.

### **3.2. PERMITS, RIGHT OF WAY, EASEMENTS AND REGULATIONS**

- 3.2.1. The Owner will provide rights-of-way for the purpose of construction without cost to the Contractor by securing permits in areas of public dedication or by obtaining easements across privately owned property. It shall be the responsibility of the Contractor, prior to the initiation of construction on easements through private property, to inform the property owner of his intent to begin construction. Before beginning construction in areas of public dedication, the Contractor shall inform the Owner seven (7) calendar days in advance thereof, and the agency having jurisdiction in the area forty-eight (48) hours prior to initiation of the work.
- 3.2.2. The Contractor shall be responsible for conducting all of his operations under the contract within the limits of the applicable easements and rights-of-way. The Contractor shall be responsible for all damages which may occur as a result of conducting any operations outside of the boundaries of the applicable servitudes, easements, and/or rights-of-way along the project site. Should the Contractor require additional right-of-way for access or egress, he shall make arrangements with the owners of such property for such right-of-way at no cost to the Owner. Upon completion of the work and prior to the Owner accepting the project, the Contractor shall provide the Owner a Letter or Release acquired from the property owner(s) in which work, access or egress was performed.
- 3.2.3. The Contractor shall procure and pay for any other permits, licenses and approvals necessary for the execution of his contract.
- 3.2.4. The Contractor shall review and be fully familiar with all terms conditions, and limitations contained in all servitudes, easements, and/or right-of-way agreements executed by all landowners along the site of the project, and shall be fully bound by all provisions contained therein. Such servitudes, easements, and right-of-way agreements shall be deemed to be a part of this contract, and any violation by the Contractor of the terms, conditions, and limitations contained therein shall be deemed to be a breach of the contract.
- 3.2.5. The Contractor shall fully defend, indemnify, and hold forever harmless the Owner, it's officers, directors, Architects, consultants, agents, servants, employees, representatives, and elected and appointed officials harmless from any and all liability of any nature or kind whatsoever, resulting and/or to result from any operations conducted by Contractor, its employees, agents, and/or representatives outside of the boundaries of any easement or right-of-way and/or any breach or violation of the terms, conditions, and/or limitations of any servitude, easement, and/or right-of-way agreement affecting property situated along the site of the project.
- 3.2.6. The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the work, the protection of adjacent property, and the maintenance of passageways, guard fences or other protective facilities. Contractor shall also construct temporary fences as needed to confine livestock to their respective pastures.

## **ARTICLE 4 PAYMENTS AND COMPLETION**

### **4.1. SCHEDULE OF VALUES**

- 4.1.1. At the Pre-Construction Conference, the Contractor shall submit to the Owner and the Architect a Schedule of Values prepared as follows:
- 4.1.1.1. CSI specification division and section numbering shall be used to correspond with the Schedule of Values Format used. If applicable, the cost of work for each section listed under each division shall be given. The cost for each section shall include labor, materials, overhead and profit.
- 4.1.1.2. The Total of all items shall equal the Total Contract Sum. This schedule, when approved by the Architect, shall be used only as a basis for the Contractor's Applications for Payment.

## 4.2. SUBSTANTIAL COMPLETION

- 4.2.1. Substantial Completion is the stage in the progress of the Work when the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The Architect shall determine if the project is substantially complete in accordance with this Subparagraph.
- 4.2.2. When the Contractor considers that the Work is Substantially Complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.
- 4.2.3. Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work is substantially complete. Prior to inspection by the Architect, the Contractor shall notify the Architect that the project is ready for inspection by the State Fire Marshal's office. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use, the Contractor shall, before acceptance of the work as Substantially Complete, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.
- 4.2.4. When the Architect makes the determination that the project is Substantially Complete, indicated in writing to the contractor, the lien period (**45 days minimum**) shall begin. At the 46th day the Contractor may then apply for final payment, which shall include all the certificates and documentation indicated in the Contract Documents, including, but not limited to the documents required by the Payment Procedures section of the Specifications.
- 4.2.5. When the Architect determines that the project is Substantially Complete, he shall prepare a "punch list" of exceptions and the dollar value related thereto. The monetary value assigned to this list will be the sum of the cost estimate for each particular item of work the Architect develops based on the mobilization, labor, material and equipment costs of correcting the item and shall be retained from the monies owed the contractor, above and beyond the standard lien retainage. Each item's assigned value shall be multiplied by two (2) for the tabulation of the total value to be withheld. The Owner retains the right to hold withheld value for punch list items completed until the end of the 45 day lien period. At the end of the 45 day lien period payment shall be approved for all punch list items completed up to that time. After that payment, none of the remaining funds shall be due the contractor until all punch list items are completed and are accepted by the Architect. If the dollar value of the punch list exceeds the amount of funds, less the retainage amount, in the remaining balance of the Contract, then the

Project shall not be accepted as substantially complete. If funds remaining are less than that required to complete the work, the Contractor shall pay the difference.

#### **4.3. FINAL COMPLETION AND FINAL PAYMENT**

4.3.1. The Contractor shall have 14 calendar days to finish all “punch list” items. At the end of the 14 day period, the Architect shall perform one additional inspection. If the work is still not acceptable and complete, the Architect and each of the Architects principle Consultants shall be paid \$250.00/ hour for all follow-up visits and field reports until all items are completed. This fee is to be withheld from the Contract sum, and payment shall be made by the Owner and deducted from the final payment.

4.3.2. Neither the final payment nor any part of the retained percentage shall come due until the Contractor delivers to the Owner a complete release of all liens arising out of this contract, or receipts in full in lieu thereof, and, if required by the Owner, an affidavit that so far as he has knowledge or information, the releases and receipts include all labor and material for which a lien could be filed; but if any subcontractor refuses to furnish a release or receipt in full, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against any lien, construction cost, or attorney's fees.

### **ARTICLE 5 SHOP DRAWINGS/ SUBMITTALS**

#### **5.1. CONTRACTOR REVIEW OF SHOP DRAWINGS/ SUBMITTALS**

5.1.1. Prior to the submission of shop drawings/submittals to the Architect by the Contractor, the Contractor review all shop drawings/submittals for compliance with the contract documents. The Contractor shall make all required corrections and notations in red ink, ink stamp each set, sign and date to indicate his approval of each prior to submission to the Architect. The Architect shall return all shop drawings/submittals as rejected where not previously reviewed by the Contractor.

5.1.2. The shop drawings/submittals required for all products included in the project shall be submitted to the Architect within 30 days of the construction time start date. The Contractor shall allow a minimum of 30 days for the Architect's/Engineer's review process. The Contractor shall coordinate the shop drawings/submittals with the construction schedule and the architectural review time to avoid delays in the work.

5.1.3. The Contractor may not request additional delay days due to the Architect's determination that the shop drawings/submittals are not in compliance with the contract documents.

5.1.4. If the shop drawings/submittals are found not in compliance with the contract documents the Architect shall stamp the documents as either “rejected” or marked “revise and re-submit” and return them to the Contractor. The Contractor shall revise and resubmit the shop drawings/submittals to the Architect for an additional review. If the drawings are still not in compliance, the Architect and each of the Architects principle Consultants shall be paid \$250.00/ hour for all subsequent reviews until all items are found in compliance. This fee is to be withheld from the Contract sum, and payment shall be made by the Owner and deducted from the final payment.

## CONTRACTOR'S CERTIFICATE OF INSURANCE

### Information purposes only

<b>THIS IS TO CERTIFY TO:</b> <b>City of Broussard</b>

That the following described policies in at least the face amounts shown below have been issued to:

Name of Insured:

Address of Insured:

Effective for the policy periods shown within the State of **LOUISIANA**.

THIS CERTIFICATE OF INSURANCE NEITHER AFFIRMATIVELY NOR NEGATIVELY AMENDS, EXTENDS, OR ALTERS THE COVERAGE AFFORDED BY POLICIES SHOWN BELOW. (CHECK APPLICABLE COVERAGES):

TYPE OF POLICY AND COVERAGE	COMPANY	NUMBER	POLICY PERIOD	POLICY MINIMUM	LIMITS OF LIABILITY LIABILITY LIMITS, UNLESS OTHERWISE REQUIRED BY CONTRACT				
I. ● STANDARD WORKER'S COMPENSATION EMPLOYER'S LIABILITY					STATUTORY \$1,000,000				
II. ● COMMERCIAL GENERAL LIABILITY A. <input type="checkbox"/> Premises Operations B. <input type="checkbox"/> Independent Contractor's Liability C. <input type="checkbox"/> Products-Completed Operations D. <input type="checkbox"/> Contractual Liability E. <input type="checkbox"/> Broad Form Property Damage					LIABILITY IN THOUSANDS				
					EACH OCCURRENCE				
					Bodily Injury				\$1000
					Property Damage				\$1000
BI & PD Combined				\$1000					
POLICY DOES <input type="checkbox"/> DOES NOT ● PROVIDE COVERAGE FOR UNDERGROUND EXPLOSION AND COLLAPSE HAZARD <b>\$1,000,000</b>									
III. ● BUSINESS AUTO LIABILITY A. <input type="checkbox"/> Any Auto B. <input type="checkbox"/> Owned C. <input type="checkbox"/> Non-Owned D. <input type="checkbox"/> Hired					LIABILITY IN THOUSANDS				
					Bodily Injury Per Accident				\$1000
					Bodily Injury Per Accident				\$1000
					Property Damage				\$1000
BI & PD Combined				\$1000					
IV. <input type="checkbox"/> UMBRELLA LIABILITY					BI & PD Combined				
NOTE:	Lower primary limits will be accepted if Umbrella Liability Coverage is provided with limits of at least \$500,000 in excess of primary coverage shown in this certificate.								
V. <input type="checkbox"/>									
VI. <input type="checkbox"/>									
VII. <input type="checkbox"/>									
IN THE EVENT OF CANCELLATION OF THE POLICY OR POLICIES OR MATERIAL CHANGES IN SUCH POLICIES, THE CERTIFICATE HOLDER SHALL RECEIVE THIRTY (30) DAYS PRIOR WRITTEN NOTICE OF SUCH CANCELLATION OR CHANGE AT THE ADDRESS STATED ABOVE BEFORE SUCH CANCELLATION OR CHANGE IS EFFECTIVE AGAINST THE CERTIFICATE HOLDER.									
Date:				BY:					
				AUTHORIZED REPRESENTATIVE:					
				ADDRESS:					

# LOUISIANA UNIFORM PUBLIC WORK BID FORM

**TO: City of Broussard**

Attn: Assistant Clerk/Deputy Clerk/City Clerk

406 E. Madison St., Bldg A

Broussard, LA 70518

*(Owner to provide name and address of owner)*

**BID FOR: A new racket center & observation deck for:  
ST JULIEN RECREATIONAL FACILITY**

701 St. Nazaire Road

Broussard, LA 70518

*(Owner to provide name of project and other identifying information)*

The undersigned bidder hereby declares and represents that she/he: a) has carefully examined and understands the Bidding Documents, b) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents or any addenda, c) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services for the construction and completion of the referenced project, all in strict accordance with the Bidding Documents prepared by: TRAHAN ARCHITECTURE + PLANNING, LLC and dated: date: 01-05-26

Bidders must acknowledge all addenda. The Bidder acknowledges receipt of the following **ADDENDA:** (Enter the number the Designer has assigned to each of the addenda that the Bidder is acknowledging) \_\_\_\_\_ .

**TOTAL BASE BID:** For all work required by the Bidding Documents (including any and all unit prices designated "Base Bid" \* but not alternates) the sum of:

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

**ALTERNATES:** For any and all work required by the Bidding Documents for Alternates including any and all unit prices designated as alternates in the unit price description.

**Alternate No. 1:** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A Dollars (\$ \_\_\_\_\_ N/A)

**Alternate No. 2:** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A Dollars (\$ \_\_\_\_\_ N/A)

**Alternate No. 3:** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A Dollars (\$ \_\_\_\_\_ N/A)

**SUBSTANTIAL COMPLETION:** Contractor agrees to substantially complete the project within 330 calendar days

**NAME OF BIDDER:** \_\_\_\_\_

**ADDRESS OF BIDDER:** \_\_\_\_\_

**LOUISIANA CONTRACTOR'S LICENSE NUMBER:** \_\_\_\_\_

**NAME OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_

**TITLE OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_

**SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER \*\*:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**THE FOLLOWING ITEMS ARE TO BE INCLUDED WITH THE SUBMISSION OF THIS LOUISIANA UNIFORM PUBLIC WORK BID FORM:**

**\*BID BOND**

**\*\* A CORPORATE RESOLUTION OR WRITTEN EVIDENCE** of the authority of the person signing the bid for the public work as prescribed by LA R.S. 38:2212(B)(5).

**\*\*\* AFFIDAVIT**

# BID BOND

Date: \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS:

That \_\_\_\_\_ of \_\_\_\_\_, as Principal, and \_\_\_\_\_, as Surety, are held and firmly bound unto the City of Broussard (Obligee), in the full and just sum of five (5%) percent of the total amount of this bid, including all alternates, lawful money of the United States, for payment of which sum, well and truly be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally firmly by these presents.

Surety represents that it is listed on the current U. S. Department of the Treasury Financial Management Service list of approved bonding companies as approved for an amount equal to or greater that the amount for which it obligates itself in this instrument or that it is a Louisiana domiciled insurance company with at least an A - rating in the latest printing of the A. M. Best's Key Rating Guide. If surety qualifies by virtue of its Best's listing, the Bond amount may not exceed ten percent of policyholders' surplus as shown in the latest A. M. Best's Key Rating Guide.

Surety further represents that it is licensed to do business in the State of Louisiana and that this Bond is signed by surety's agent or attorney-in-fact. This Bid Bond is accompanied by appropriate power of attorney.

THE CONDITION OF THIS OBLIGATION IS SUCH that, whereas said Principal is herewith submitting its proposal to the Obligee on a Contract for:

**A new racket center & observation deck for:  
ST JULIEN RECREATIONAL FACILITY**

NOW, THEREFORE, if the said Contract be awarded to the Principal and the Principal shall, within such time as may be specified, enter into the Contract in writing and give a good and sufficient bond to secure the performance of the terms and conditions of the Contract with surety acceptable to the Obligee, then this obligation shall be void; otherwise this obligation shall become due and payable.

\_\_\_\_\_  
PRINCIPAL (BIDDER)

\_\_\_\_\_  
SURETY

BY: \_\_\_\_\_  
AUTHORIZED OFFICER-OWNER-PARTNER

BY: \_\_\_\_\_  
AGENT OR ATTORNEY-IN-FACT (SEAL)

STATE OF \_\_\_\_\_

PARISH OF \_\_\_\_\_

**ATTESTATIONS AFFIDAVIT**

**Before me**, the undersigned notary public, duly commissioned and qualified in and for the parish and state aforesaid, personally came and appeared Affiant, who after being duly sworn, attested as follows:

**L.A. R.S. 38:2227 PAST CRIMINAL CONVICTIONS OF BIDDERS**

A. No sole proprietor or individual partner, incorporated, director, or manager, officer, organizer, or member who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes:

- |                                      |                                   |
|--------------------------------------|-----------------------------------|
| (a) Public bribery (R.S.14:118)      | (c) Extortion (R.S. 14:66)        |
| (b) Corrupt influencing (R.S.14:120) | (d) Money laundering (R.S. 14:23) |

B. Within the past five years from the project bid date, no sole proprietor or individual partner, incorporator, director, manager, officer, organizer, or member who has a minimum of a ten percent (10%) ownership in the bidding entity named below has been convicted of, or has entered a plea of guilty or nolo contendere to any of the following state crimes or equivalent federal crimes, during the solicitation or execution of a contract or bid awarded pursuant to the provisions of Chapter 10 of Title 38 of the Louisiana Revised Statutes:

- |   |  |
|---|--|
| (a) Theft (R.S. 14:67)                            | (f) Bank fraud (R.S. 14:71.1)                                |
| (b) Identity Theft (R.S. 14:67.16)                | (g) Forgery (R.S. 14:72)                                     |
| (c) Theft of a business record<br>(R.S. 14:67.20) | (h) Contractors; misapplication of<br>payments (R.S. 14:202) |
| (d) False accounting (R.S. 14:70)                 | (i) Malfeasance in office (R.S. 14:134)                      |
| (e) Issuing worthless checks<br>(R.S. 14:71)      |  |

**L.A. R.S. 38:2212.10 Verification of Employees**

- A. At the time of bidding, Appearer is registered and participates in a status verification system to verify that all new hires in the state of Louisiana are legal citizens of the United States or are legal aliens.
- B. If awarded the contract, Appearer shall continue, during the term of the contract, to utilize a status verification system to verify the legal status of all new employees in the state of Louisiana.
- C. If awarded the contract, Appearer shall require all subcontractors to submit to it a sworn affidavit verifying compliance with Paragraphs (A) and (B) of this Subsection.

**L.A. R.S. 23:1726 (B) Certification Regarding Unpaid Workers Compensation Insurance**

- A. R.S. 23:1726 prohibits any entity against whom an assessment under Part X of Chapter 11 of Title 23 of the Louisiana Revised Statutes of 1950 (Alternative Collection Procedures & Assessments) is in effect, and whose right to appeal that assessment is exhausted, from submitting a bid or proposal for obtaining any contract pursuant to Chapter 10 of Title 38 of the Louisiana Revised Statutes of 1950 and Chapters 16 and 17 of Title 39 of the Louisiana Revised Statutes of 1950.
  
- B. By signing this bid / proposal, Affiant certifies that no such assessment is in effect against the bidding / proposing entity.

\_\_\_\_\_  
**NAME OF BIDDER**

\_\_\_\_\_  
**NAME OF AUTHORIZED SIGNATORY OF BIDDER**

\_\_\_\_\_  
**DATE**

\_\_\_\_\_  
**TITLE OF AUTHORIZED SIGNATURE OF BIDDER**

\_\_\_\_\_  
**SIGNATURE OF AUTHORIZED  
SIGNATORY OF BIDDER/AFFIANT**

**Sworn to and subscribed** before me by Affiant on the \_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

\_\_\_\_\_  
Notary Public

**AFFIDAVIT**

STATE OF LOUISIANA:

PARISH OF \_\_\_\_\_

The Undersigned, \_\_\_\_\_, being first duly sworn, deposes and affirms that:

1. He is the \_\_\_\_\_ of \_\_\_\_\_  
(Office, position, owner) (Bidding Firm Name)  
 the party making the attached bid;
2. The attached bid is genuine, and all statements contained therein are true;
3. The bidder has not by collusion or agreement or conference or in any other way, conspired to fix the bid price or to secure any unfair advantage;
4. The bidder has employed no person, corporation, firm, association, or other organization, either directly or indirectly, to secure this public contract, other than persons regularly employed by the bidder in the regular course of their duties;
5. The bidder has not paid and will not pay any part of the bid price to any person, corporation, firm, association, or other organization for soliciting the contract, other than the payment of normal compensation to persons regularly employed by the bidder whose services in connection with the construction of the public project are in regular course of their duties for the bidder.

Signed by \_\_\_\_\_  
(Bidder if an individual, partner if a partnership, officer if a corporation)

Title \_\_\_\_\_

Subscribed and Sworn to this \_\_\_\_\_ day of \_\_\_\_\_, 2026.

By \_\_\_\_\_  
Notary Public

END OF SECTION

## PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned \_\_\_\_\_ as Principal, and \_\_\_\_\_ a Corporation duly authorized to transact business in the State of Louisiana, as Surety, are held and firmly bound unto the City of Broussard, existing under the laws of the State of Louisiana, in the penal sum of

\_\_\_\_\_ lawful money of the United States, for the payment of which will and truly to be made, the said surety does hereby bind ourselves, our heirs, executors, administrators, and assigns, jointly and severally, by these presents as follows:

WHEREAS, the Principal has entered into a Contract with the City of Broussard, bearing the date of \_\_\_\_\_, for **A new racket center & observation deck for: ST JULIEN RECREATIONAL FACILITY** upon certain terms and conditions, completely set out in said Contract; and

WHEREAS, it was one of the conditions of award by the City of Broussard, pursuant to which the contract hereinabove referred to was entered into, that these presents shall be executed:

NOW, THEREFORE the conditions of this obligation are such that if the Principal shall in all respects fully comply with the terms and conditions of said Contract and his obligations thereunder, including the specifications, proposals and plans therein referred to and made a part thereof, and such alterations as may be made on such plans and specifications as therein provided for, and shall indemnify and save harmless the City of Broussard against or from all costs, expenses, damages, injury or loss, to which the City of Broussard may be subjected by reason of any wrongdoing, misconduct, want of care or skill, negligence, or default including patent infringement on the part of the Principal, his agents or employees, in the execution of performance of said Contract, and shall promptly pay all claims for damages or injury to property and for work done, or skill, tools, machinery, supplies, labor and materials furnished and debts incurred by the Principal in or about the performance of the work contracted for, this obligation to be void.

And the Surety, for value received hereby stipulates and agrees that no change, extension of time, or alteration or addition to the terms of the Contract or the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work or to the specifications.

PERFORMANCE AND PAYMENT BOND

This bond shall be for the use of the City of Broussard and all persons doing work or furnishing skill, tools, machinery or materials for the purpose of the Contract herein above referred to.

In Testimony whereof, the Principal and the Surety have caused these presents to be duly signed and sealed in two (2) counterparts this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

EXECUTED IN TWO (2) COUNTERPARTS

WITNESSES:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

BY \_\_\_\_\_

\_\_\_\_\_

BY \_\_\_\_\_

LA. LICENSE NO. \_\_\_\_\_

## **SAMPLE CORPORATE RESOLUTION**

The attached document is a sample document only. You may submit your Corporate Resolution that you currently have on file or you may elect to use this format as an acceptable form of a Corporate Resolution.

A signed copy of your Corporate Resolution is required to be submitted with your bid regardless of who is authorized to sign the bid. Failure to submit your Corporate Resolution with your bid shall be cause for rejection of bid.

**Company Letterhead**

**Address  
Phone  
Fax**

---

Certificate of Authority

City of Broussard

Attn: \_\_\_\_\_

406 E. Madison St., Bldg A

Broussard, LA 70518

Re: **Specific Project Name or left blank for Any Project**

To Whom It May Concern,

I, individually and on behalf of **Company Name**, do by my signature below, certify that:

**Company Name** is a **limited liability company (if LLC, or define type)** duly organized and existing under the laws of **Louisiana**;

I am the **Secretary, an officer of the Company**, authorized to sign on its behalf: and

**Name, President**, is an officer of the Company authorized to make, execute and approve, on behalf of this Company, any and all contracts, or amendments thereof, entered into by and between **Company Name** and the City of Broussard.

In witness whereof, I hereby set my hand this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Signature

Name

Company Title

Company Name

Phone Fax Etc.

Notary

Seal

## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents.
  - 2. Work phases.
  - 3. Work under other contracts.
  - 4. Use of premises.
  - 5. Owner's occupancy requirements.
  - 6. Specification formats and conventions.
- B. See Division 01 Section "Multiple Contract Summary" for division of responsibilities for the Work.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: **A new racket center & observation deck for: ST JULIEN RECREATIONAL FACILITY**
  - 1. Project Location: 701 St. Nazare Rd., Broussard, LA 70518
- B. Owner: City of Broussard
  - 1. Owner's Representative: Jamie Abshire, Director of Parks & Recreation
- C. Architect: Trahan Architecture + Planning, LLC
- D. The Work consists of the following:
  - 1. The Work includes
    - a. New Concession Building, Pro-Shop / Observation Building.
    - b. Conversion and Expansion of existing Basketball court to new 4 Court Covered Pickleball court area,
    - c. New 12 Court Pickleball Courts area, Covered.
    - d. New 10 Court Pickleball Courts area.
    - e. All site and utility work as indicated in the drawings and in association with the project.
- E. Project will be constructed under a single prime contract.

### 1.3 WORK UNDER OTHER CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

### 1.4 USE OF PREMISES

- A. Use of Site: Limit use of premises to areas within the contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Limits: Confine constructions operations to area of work indicated in the drawings.
  - 2. Contractor shall coordinate work to allow for safe access to the existing Tennis Courts, which shall remain in use during the construction.

### 1.5 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
  - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
  - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
  - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
  - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

### 1.6 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. See Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
- C. See Division 01 Section "Unit Prices" for administrative requirements for using unit prices.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

#### 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 20 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

#### 1.4 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
  2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than **21** days after such authorization.

#### 1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

## SECTION 012900 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets and Contractor's Construction Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Submit draft of AIA Document G703 Continuation Sheets.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
  - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  - 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - 6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
  - 7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

### 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Progress payments shall be submitted to Architect by the first (1<sup>st</sup>) of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
  2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of Values.
  3. Contractor's Construction Schedule (preliminary if not final).
  4. Schedule of unit prices.
  5. Submittals Schedule (preliminary if not final).
  6. List of Contractor's staff assignments.
  7. List of Contractor's principal consultants.
  8. Copies of building permits.
  9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  10. Initial progress report.
  11. Report of preconstruction conference.
  12. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Project meetings.
  - 3. Requests for Interpretation (RFIs).
- B. See Division 01 Section "Multiple Contract Summary" for a description of the division of Work among separate contracts and responsibility for coordination activities not in this Section.
- C. See Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

#### 1.2 DEFINITIONS

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

#### 1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.
  9. Project closeout activities.

#### 1.4 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. Preparation of Record Documents.

- l. Use of the premises.
  - m. Work restrictions.
  - n. Owner's occupancy requirements.
  - o. Responsibility for temporary facilities and controls.
  - p. Construction waste management and recycling.
  - q. Parking availability.
  - r. Office, work, and storage areas.
  - s. Equipment deliveries and priorities.
  - t. First aid.
  - u. Security.
  - v. Progress cleaning.
  - w. Working hours.
3. Minutes: Architect will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at bi-monthly intervals. Coordinate dates of meetings with preparation of payment requests. (Additional meetings where required due to construction milestones or where requested by the Architect / Owner)
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Status of correction of deficient items.
      - 14) Field observations.
      - 15) RFIs.
      - 16) Status of proposal requests.
      - 17) Pending changes.
      - 18) Status of Change Orders.
      - 19) Pending claims and disputes.

20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Reports shall be issued no later than 72 hours following the meeting.
  - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

#### 1.5 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
  1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
  1. Project name.
  2. Date.
  3. Name of Contractor.
  4. Name of Architect and Construction Manager.
  5. RFI number, numbered sequentially.
  6. Specification Section number and title and related paragraphs, as appropriate.
  7. Drawing number and detail references, as appropriate.
  8. Field dimensions and conditions, as appropriate.
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature.
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Hard-Copy RFIs: CSI Form 13.2A.
  1. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
  1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
  - c. Requests for coordination information already indicated in the Contract Documents.
  - d. Requests for adjustments in the Contract Time or the Contract Sum.
  - e. Requests for interpretation of Architect's actions on submittals.
  - f. Incomplete RFIs or RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Use CSI Log Form 13.2B. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Site condition reports.

#### 1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
  2. PDF file.
  3. Two paper copies, of sufficient size to display entire period or schedule, as required.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
  2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
  3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit on Friday of every week.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

#### 1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

#### 1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
1. Use Microsoft Project, Primavera, Meridian Prolog, or where Pre-Approved by the Architect prior to bidding, for current Windows operating system.

- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
  
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  - 5. Punch List and Final Completion: Include not more than 21 days for completion of punch list items and final completion.
  
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Phasing: Arrange list of activities on schedule by phase.
  - 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  - 3. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use-of-premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
  
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

## 1.6 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
  1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 1.7 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner that may affect or be affected by Contractor's activities.
    - i. Testing and inspection.
    - j. Commissioning.
    - k. Punch list and final completion.
    - l. Activities occurring following final completion.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
  - 1. Contractor or subcontractor and the Work or activity.
  - 2. Description of activity.
  - 3. Main events of activity.
  - 4. Immediate preceding and succeeding activities.
  - 5. Early and late start dates.
  - 6. Early and late finish dates.
  - 7. Activity duration in workdays.
  - 8. Total float or slack time.
  - 9. Average size of workforce.
  - 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
  - 1. Identification of activities that have changed.
  - 2. Changes in early and late start dates.
  - 3. Changes in early and late finish dates.
  - 4. Changes in activity durations in workdays.
  - 5. Changes in the critical path.
  - 6. Changes in total float or slack time.
  - 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
  - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  - 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 1.8 REPORTS

- A. **Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site. Reports shall be submitted to the Architect**

**every Friday and shall include photographs, taken from vantage point that best suits the construction activities that occurred within the time period being reported.:**

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Construction Change Directives received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section "Photographic Documentation" for submitting construction photographs.
- D. See Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
- E. See Division 01 Section "Closeout Procedures" for submitting warranties.
- F. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- G. See Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- H. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

#### 1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately **6 by 8 inches (150 by 200 mm)** on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    - i. Number and title of appropriate Specification Section.
    - j. Drawing number and detail references, as appropriate.
    - k. Location(s) where product is to be installed, as appropriate.
    - l. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Use AIA Document G810.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are noted as either “no exceptions” or “exceptions as noted” and signed by the Architect
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating "Approved" and signed by the Architect.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Manufacturer's catalog cuts.
    - e. Wiring diagrams showing factory-installed wiring.
    - f. Printed performance curves.
    - g. Operational range diagrams.
    - h. Compliance with specified referenced standards.
    - i. Testing by recognized testing agency.

4. Number of Copies: Submit six copies of Product Data, unless otherwise indicated. Architect will return five copies. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.
    - d. Roughing-in and setting diagrams.
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    - f. Shopwork manufacturing instructions.
    - g. Templates and patterns.
    - h. Schedules.
    - i. Notation of coordination requirements.
    - j. Notation of dimensions established by field measurement.
    - k. Relationship to adjoining construction clearly indicated.
    - l. Seal and signature of professional engineer if specified.
    - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of appropriate Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  - 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
  - E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
    - 1. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
  - F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
  - G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
  - H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
  - I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A.
    - 1. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
- 2.2 INFORMATIONAL SUBMITTALS
- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
    - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
    - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from an International Building Code and National Fire Protection Agency organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
  - 1. Statement on condition of substrates and their acceptability for installation of product.
  - 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- U. Construction Photographs Comply with requirements specified in Division 01 Section "Photographic Documentation."

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Review Stamp: Stamp each submittal with a uniform, review stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
  - 1. **"No exceptions"** or "Exceptions as noted", followed by the Architects signature.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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 -control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 49 Sections for specific test and inspection requirements.

#### 1.2 DEFINITIONS

- A. 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.
- B. 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. Services do not include contract enforcement activities performed by Architect.
- C. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- D. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- E. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- F. 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, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name,

such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

- G. Experienced: When used with an entity, "experienced" means having successfully completed at least 3 previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.4 SUBMITTALS

- A. Qualification Data: 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.
- B. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number 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 inspecting.
  - 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.
- C. Permits, Licenses, and Certificates: For Owner's records, 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.

## 1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, 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.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

## 1.6 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 inspecting 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. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

- a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 72 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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. **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 Division 01 Section "Submittal Procedures."
- D. **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.
- E. **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 location 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 any duties of Contractor.
- F. **Associated Services:** Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.

- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## 1.7 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. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  - 2. 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.
  - 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  - 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 5. Retesting and reinspecting corrected work.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 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 014000

## SECTION 014200 - REFERENCES

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the organizations responsible for the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl1

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)
CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification
FTMS	Federal Test Method Standard (See FS)
MIL	(See MILSPEC)
MIL-STD	(See MILSPEC)
MILSPEC	Military Specification and Standards
UFAS	Uniform Federal Accessibility Standards

### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl2

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association

AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists (The)
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	APA - The Engineered Wood Association
APA	Architectural Precast Association
API	American Petroleum Institute

ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)
AWCMA	American Window Covering Manufacturers Association (Now WCSC)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association

CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet & Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
FIBA	Federation Internationale de Basketball Amateur (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FMG	FM Global (Formerly: FM - Factory Mutual System)
FMRC	Factory Mutual Research (Now FMG)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association

FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Now GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek
ITU	International Telecommunication Union

KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association

NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Acquired by ITS - Intertek)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute

RIS	Redwood Inspection Service
RTI	(Formerly: NTRMA - National Tile Roofing Manufacturers Association) (Now TRI)
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society

TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute (Formerly: RTI - Roof Tile Institute)
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association (Now WCSC)
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl3

BOCA	BOCA International, Inc. (See ICC)
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials (See ICC)
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)

ICC International Code Council  
ICC-ES ICC Evaluation Service, Inc.  
SBCCI Southern Building Code Congress International, Inc. (See ICC)

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl4

CE Army Corps of Engineers  
CPSC Consumer Product Safety Commission  
DOC Department of Commerce  
DOD Department of Defense  
DOE Department of Energy  
EPA Environmental Protection Agency  
FAA Federal Aviation Administration  
FCC Federal Communications Commission  
FDA Food and Drug Administration  
GSA General Services Administration  
HUD Department of Housing and Urban Development  
LBL Lawrence Berkeley National Laboratory  
NCHRP National Cooperative Highway Research Program (See TRB)  
NIST National Institute of Standards and Technology  
OSHA Occupational Safety & Health Administration  
PBS Public Building Service (See GSA)  
PHS Office of Public Health and Science  
RUS Rural Utilities Service (See USDA)  
SD State Department  
TRB Transportation Research Board

USDA Department of Agriculture

USPS Postal Service

D. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl5

CBHF State of California, Department of Consumer Affairs  
Bureau of Home Furnishings and Thermal Insulation

CPUC California Public Utilities Commission

TFS Texas Forest Service  
Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. See Division 01 Section "Multiple Contract Summary" for division of responsibilities for temporary facilities and controls.
- C. See Division 01 Section "Execution" for progress cleaning requirements.
- D. See Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
- E. See Division 31 Section "Dewatering" for disposal of ground water at Project site.

#### 1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

#### 1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### 1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

## 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Pavement: Comply with Division 32 pavement and cast in place concrete Sections.
- B. Chain-Link Fencing: Minimum **2-inch (50-mm)**, **0.148-inch- (3.76-mm-)** thick, galvanized steel, chain-link fabric fencing; minimum **6 feet (1.8 m)** high with galvanized steel pipe posts; minimum **2-3/8-inch- (60-mm-)** OD line posts and **2-7/8-inch- (73-mm-)** OD corner and pull posts, with **1-5/8-inch- (42-mm-)** OD top rails.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Provide Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
- C. Protection of existing Tennis Court system:
  - 1. Contractor shall provide:
    - a. temporary protection (wood framed plywood covered walls and ceilings (as needed)) as needed to protect the occupants and existing fencing during construction.
    - b. Where construction activities interfere with access to the existing front gate systems of the courts, the contractor shall provide for temporary gravel walkways to access the rear court gates. These shall be maintained as needed for safe access by the occupants during construction, then removed at the completion. The contractor shall hydroseed as needed where existing grass is removed during the removal of the gravel.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
  - 2. Where construction disturbs the existing tennis court lighting, the contractor shall Provide temporary power to existing Tennis court lighting until repaired or replaced by the current design.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to the existing sewage service lines as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from

adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead or underground, unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service:
  - 1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail in field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
  - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within the common future parking area and area of construction.
  - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel. Parking shall be coordinated with the owner during the pre-construction meeting.

- E. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
  - 1. Provide temporary, directional signs for construction personnel and visitors.
  - 2. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- I. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

#### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
  2. Construct dustproof partitions with 2 layers of 3-mil (0.07-mm) polyethylene sheet on each side. Cover floor with 2 layers of 3-mil (0.07-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
    - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
  3. Insulate partitions to provide noise protection to occupied areas.
  4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  5. Protect air-handling equipment.
  6. Weather strip openings.
  7. Provide walk-off mats at each entrance through temporary partition.
- K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

#### 1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

#### 1.3 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
  2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    - j. Cost information, including a proposal of change, if any, in the Contract Sum.
    - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Acceptance: Change Order.
    - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable

product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
- b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  - 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," Architect will make selection.
  - 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
4. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
5. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
6. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

### 2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Progress cleaning.
  - 5. Starting and adjusting.
  - 6. Protection of installed construction.
  - 7. Correction of the Work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

#### 1.2 SUBMITTALS

- A. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit 3 copies signed by professional engineer.
- D. Final Property Survey: Submit 3 copies showing the Work performed and record survey data.

#### 1.3 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.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and 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. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a professional engineer to lay out the Work using 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level, and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. 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.
- E. 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 logged available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. 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.
- B. Benchmarks: Establish and maintain a minimum of two 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.
- C. 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.

- D. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: 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.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. 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.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- 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 according to 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- 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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.8 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. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

## SECTION 017329 - CUTTING AND PATCHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- C. See Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

#### 1.2 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
  - 3. Products: List products to be used and firms or entities that will perform the Work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
  - 6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

#### 1.3 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
  - 1. Neither the General Contractor nor the Contractor's Subs shall cut or patch any structural element without the approval of both the Architect and the Engineer. This includes, but is not limited to beams, columns, trusses, headers, strongbacks etc.
- B. 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.

- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials 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 match the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. 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.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

### 3.3 PERFORMANCE

- 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. 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 as small as possible, neatly to 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 Division 31 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.
- C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. See Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
- D. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- E. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- F. See Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- G. See Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### 1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

### 1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
  - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

#### 1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch (215-by-280-mm)** paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. 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.

### PART 3 - EXECUTION

#### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. 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.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - l. 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 already show evidence of repair or restoration.
      - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Replace parts subject to unusual operating conditions.
    - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    - r. Leave Project clean and ready for occupancy.

- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Emergency manuals.
  - 2. Operation manuals for systems, subsystems, and equipment.
  - 3. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. See Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

#### 1.2 SUBMITTALS

- A. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return a copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

### PART 2 - PRODUCTS

#### 2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.
  - 6. Name and address of Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire flood water leak power failure water outage and equipment failure.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

## 2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Equipment identification with serial number of each component.
  - 4. Equipment function.
  - 5. Operating characteristics.
  - 6. Limiting conditions.
  - 7. Performance curves.
  - 8. Engineering data and tests.
  - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.

- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## 2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

#### 1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit 1 set of marked-up Record Prints.
    - a. Final Submittal: Submit 1 set of marked-up Record Prints.
- B. Record Specifications: Submit 1 copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit 1 copy of each Product Data submittal.

### PART 2 - PRODUCTS

#### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

- b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Transparencies: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.
  1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
  2. Refer instances of uncertainty to Architect for resolution.
  3. Owner will furnish Contractor one set of transparencies of the Contract Drawings for use in recording information.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. Note related Change Orders and Record Drawings where applicable.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

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

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

## SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Form-facing material for cast-in-place concrete.
  2. Shoring, bracing, and anchoring.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each of the following:
1. Exposed surface form-facing material.
  2. Concealed surface form-facing material.
  3. Form ties.
  4. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
    - a. Location of construction joints is subject to approval of the Architect.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
  2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

## 2.2 FORM-FACING MATERIALS

### A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.

### B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

## 2.3 RELATED MATERIALS

### A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

### B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

### C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF FORMWORK

#### A. Comply with ACI 301 (ACI 301M).

#### B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

#### C. Limit concrete surface irregularities as follows:

1. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).

- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips.
  - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).
- K. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
  - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
  - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 3. Place joints perpendicular to main reinforcement.
  - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
    - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  3. Clean embedded items immediately prior to concrete placement.
  - 4.

### 3.3 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

## SECTION 032000 - CONCRETE REINFORCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Steel reinforcement bars.
  2. Welded-wire reinforcement.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Each type of steel reinforcement.
  2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
1. Include placing drawings that detail fabrication, bending, and placement.
  2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of Architect.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- B. Material Test Reports: For the following, from a qualified testing agency:
1. Steel Reinforcement:
    - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- C. Field quality-control reports.

## 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

## PART 2 - PRODUCTS

### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420) deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

### 2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
  - 1. Finish: Plain.

### 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
  2. Stagger splices in accordance with ACI 318 (ACI 318M).
  3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches (305 mm).
  2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
  3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement.
  2. Continue reinforcement across construction joints unless otherwise indicated.
  3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
  - 1. Steel-reinforcement placement.
  - 2. Steel-reinforcement welding.

END OF SECTION 032000

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

##### B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
7. Vapor retarders.
8. Liquid floor treatments.
9. Curing materials.
10. Joint fillers.

- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
  2. Minimum 28-day compressive strength.
  3. Durability exposure class.
  4. Maximum w/cm.
  5. Calculated equilibrium unit weight, for lightweight concrete.
  6. Slump limit.
  7. Air content.
  8. Nominal maximum aggregate size.
  9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  10. Intended placement method.
  11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
    - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
  2. Location within Project.
  3. Exposure Class designation.
  4. Formed Surface Finish designation and final finish.
  5. Final finish for floors.
  6. Curing process.
  7. Floor treatment if any.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Curing compounds.
  4. Vapor retarders.
  5. Joint-filler strips.
- B. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
  2. Fly ash.
  3. Slag cement.
  4. Blended hydraulic cement.

- 5. Aggregates.
- 6. Admixtures:
  
- C. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- D. Preconstruction Test Reports: For each mix design.
- E. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
  - 1. Include the following information in each test report:
    - a. Admixture dosage rates.
    - b. Slump.
    - c. Air content.
    - d. Seven-day compressive strength.
    - e. 28-day compressive strength.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M).

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

### 2.2 CONCRETE MATERIALS

#### A. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/4 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Air-Entraining Admixture: ASTM C260/C260M.

- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride[ in steel-reinforced concrete].

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

### 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A>; not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Stego
2. Xtreme Vapor Barrier

### 2.4 CURING MATERIALS

- A. Water: Potable or complying with ASTM C1602/C1602M.

- B. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber] or ASTM D1752, cork or self-expanding cork.

## 2.6 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
  - 2. Slag Cement: 50 percent by mass.
  - 3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
  - 4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.

## 2.7 CONCRETE MIXTURES

- A. Class [A]: Normal-weight concrete used for footings, grade beams, and tie beams.
  - 1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
  - 2. Maximum w/cm: 0.50.
  - 3. Air Content: 5%
- B. Class [B] Insert designation: Normal-weight concrete used for slabs-on-ground.
  - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 2. Maximum w/cm: 0.50.
  - 3. Air Content: 5%
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- C. Class [C]: Normal-weight concrete used for suspended slabs.
  - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
  - 2. Maximum w/cm: 0.45.
  - 3. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).

4. Air Content: 5%
  - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

### 3.2 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  2. Face laps away from exposed direction of concrete pour.
  3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
  4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
  5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

### 3.3 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth depth of concrete thickness as follows:
1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Scream slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1 inch (25 mm).
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/4 inch (6 mm).
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

### 3.6 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
- 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
  - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.
  - 3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish:
- 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
  - 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
  - 3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish:
- 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
  - 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  4. Do not add water to concrete surface.
  5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
  6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm) and also no more than 1/16 inch (1.6 mm) in 2 feet (610 mm).
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings . While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
1. Coordinate required final finish with Architect before application.
  2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  2. Coordinate required final finish with Architect before application.

### 3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 6 inches (150 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
  2. Screed, tamp, and trowel finish concrete surfaces.

### 3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  2. If forms remain during curing period, moist cure after loosening forms.
  3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
      - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
  - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
    - 1) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      - a) Water.
      - b) Continuous water-fog spray.
  - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
    - 1) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      - a) Water.
      - b) Continuous water-fog spray.
  - c. Floors to Receive Polished Finish: Contractor has option of the following:
    - 1) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
      - a) Water.
      - b) Continuous water-fog spray.
  - d. Floors to Receive Chemical Stain:
    - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
    - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
    - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
    - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
  - e. Floors to Receive Urethane Flooring:
    - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches (150 mm) and sealed in place.

- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.9 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

### 3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
  4. Rinse with water; remove excess material until surface is dry.
  5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

### 3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  - 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
  - 1. Headed bolts and studs.
  - 2. Verification of use of required design mixture.
  - 3. Concrete placement, including conveying and depositing.
  - 4. Curing procedures and maintenance of curing temperature.
  - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.

6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M:
    - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C31/C31M:
    - a. Cast and laboratory cure two sets of [two] [three] [four] 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
    - b. Cast, initial cure, and field cure two sets of four standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C39/C39M.
    - a. Test one set of four laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    - b. Test one set of four field-cured specimens at seven days and one set of two specimens at 28 days.
    - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
  9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  10. Additional Tests:
    - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
      - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
  11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Architect.

### 3.12 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
  2. Diaper hydraulic equipment used over concrete surfaces.
  3. Prohibit vehicles from interior concrete slabs.
  4. Prohibit use of pipe-cutting machinery over concrete surfaces.
  5. Prohibit placement of steel items on concrete surfaces.
  6. Prohibit use of acids or acidic detergents over concrete surfaces.
  7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

## SECTION 033816 - UNBONDED POST-TENSIONED CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Post-tensioning tendons and accessories, including pocket formers, bar chairs, slab bolsters, and nonprestressed reinforcement required for installing post-tensioning tendons.
2. Post-tensioning operations, including stressing, recording tendon elongations and gage pressures, and finishing tendons.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Evaluation Reports: For anchorage devices and couplers.
- C. Product Certificates: For encapsulation systems.
- D. Mill Test Reports: For prestressing strand.
- E. Field quality-control reports.
- F. Stressing Records: Submit the same day as stressing operations.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."
- B. Installer Qualifications: A qualified installer whose full-time Project superintendent has successfully completed PTI's Level 1 - Field Fundamentals course or has equivalent verifiable experience and knowledge acceptable to Architect.
  1. Superintendent to be trained by post-tensioning supplier in the operation of stressing equipment to be used on Project.
- C. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1. Testing Agency Inspector: Personnel performing field inspections and measuring elongations to have successfully completed PTI's Level 1 - Field Fundamentals course or to have equivalent verifiable experience and knowledge acceptable to Architect.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle post-tensioning materials according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."

## PART 2 - PRODUCTS

### 2.1 PRESTRESSING TENDONS

- A. ACI Publications: Comply with ACI 423.7 unless otherwise indicated.
- B. Prestressing Strand: ASTM A416/A416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation, 0.5-inch- (12.7-mm-) diameter strand.
- C. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties; chemically stable and nonreactive with prestressing strand, nonprestressed reinforcement, sheathing material, and concrete.
- D. Tendon Sheathing:
  1. Material: Polyethylene or polypropylene with a minimum density of 0.034 lb/cu. in. (0.9 g/cu. cm).
  2. Minimum Thickness: 0.050 inch (1.25 mm).
  3. Continuous over length of tendon between anchorages to prevent intrusion of cement paste or loss of coating for a nonencapsulated system.
- E. Anchorage and Coupler Assemblies: Assemblies of prestressing strand, wedges, and anchor or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.

### 2.2 NONPRESTRESSED STEEL BARS

- A. <Double click to insert sustainable design text for recycled content of steel products.>
- B. Support Bars, Reinforcing Bars, and Hairpins:
  1. Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- C. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons and tendon support bars in place. Manufacture bar supports, according to CRSI's "Manual of Standard Practice," from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
  1. Use all-plastic bar supports.

## 2.3 ACCESSORIES

- A. Pocket Formers: Capable of completely sealing wedge cavity; sized to provide the required cover over the anchorage and allow access for cutting strand tail.
- B. Anchorage Fasteners: Uncoated-steel nails, wires, and screws used to attach anchorages to formwork.
- C. Sheathing Repair Tape: Elastic, self-adhesive, moistureproof tape with minimum width of 2 inches (50 mm), in contrasting color to tendon sheathing; nonreactive with sheathing, coating, or prestressing steel.

## 2.4 PATCHING MATERIAL

- A. One-component, polymer-modified, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead applications. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF NONPRESTRESSED STEEL REINFORCEMENT

- A. Placement of nonprestressed steel reinforcement is specified in Section 033000 "Cast-in-Place Concrete." Coordinate placement of nonprestressed steel reinforcement with installation of post-tensioning tendons.

### 3.2 INSTALLATION OF TENDON

- A. Install tendons according to installation drawings and procedures stated in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."
  - 1. Tolerances: Comply with tolerances in ACI 423.7 for beams and slabs.
- B. Tendon Supports: Provide continuous slab bolsters or bars supported on individual high chairs spaced at a maximum of 48 inches (1070 mm) o.c. to ensure tendons remain in their designated positions during construction operations and concrete placement.
  - 1. Support tendons as required to provide profiles shown on installation drawings. Position supports at high and low points and at intervals not exceeding 48 inches (1220 mm). Ensure that tendon profiles between high and low points are smooth parabolic curves.
  - 2. Attach tendons to supporting chairs and reinforcement without damaging tendon sheathing.
- C. Maintain tendon profile within maximum allowable deviations from design profile as follows:
  - 1. 1/4 inch (6.3 mm) for member depth less than or equal to 8 inches (200 mm).

- D. Maintain minimum radius of curvature of 480-strand diameters for lateral deviations to avoid openings, ducts, and embedded items. Maintain a minimum of 2 inches (50 mm) of separation between tendons at locations of curvature.
- E. If tendon locations conflict with nonprestressed reinforcement or embedded items, tendon placement governs. Obtain Architect's approval before relocating tendons or tendon anchorages that interfere with one another.
- F. Deviations in horizontal spacing and location of slab tendons are permitted when required to avoid openings and inserts.
- G. Installation of Anchorages:
  1. Place anchorages at locations shown on approved installation drawings.
  2. Attach pocket formers, intermediate anchorages, and stressing-end anchorages securely to bulkhead forms. Install stressing-end and intermediate anchorages perpendicular to tendon axis.
  3. Install tendons straight, without vertical or horizontal curvature, for a minimum of 12 inches (300 mm) behind stressing-end and intermediate anchorages.
  4. Embed intermediate anchorage devices at construction joints in first concrete placed at joint.
  5. Minimum splice length in reinforcing bars at anchorages is 24 inches (600 mm). Stagger splices a minimum of 60 inches (1500 mm).
  6. Place fixed-end anchorages in formwork at locations shown on installation drawings. Support anchorages firmly to avoid movement during concrete placement.
- H. Maintain minimum concrete cover according to ACI 423.7.
- I. Maintain minimum clearance of 6 inches (150 mm) between tendons and openings.
- J. Prior to concrete placement, mark tendon locations on formwork with spray paint.
- K. Do not install sleeves within 36 inches (914 mm) of anchorages after tendon layout has been inspected.
- L. Do not install conduit, pipe, or embeds requiring movement of tendons after tendon layout has been inspected.
- M. Do not use couplers unless location has been approved by Architect.

### 3.3 SHEATHING INSPECTION AND REPAIR

- A. Inspect sheathing for damage after installing tendons. Repair damaged areas by restoring post-tensioning coating and repairing or replacing tendon sheathing.
  1. Ensure that sheathing is watertight and there are no air voids.
  2. Follow tape repair procedures in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."
- B. Maximum length of exposed strand behind anchorages is as follows:

1. Fixed End: 12 inches (300 mm).
  2. Intermediate and Stressing End: 8 inches (200 mm).
    - a. Cover exposed strand with sheathing repair tape to prevent contact with concrete.
- C. Immediately remove and replace tendons that have damaged strand.

### 3.4 CONCRETE PLACEMENT

- A. Ensure compaction of concrete around anchorages.
- B. Ensure that position of tendons and nonprestressed-steel reinforcement do not change during concrete placement. Reposition tendons and nonprestressed-steel reinforcement moved during concrete placement to original location.
- C. Ensure that method of concrete placement does not damage tendon sheathing. Do not support pump lines, chutes, or other concrete-placing equipment on tendons.

### 3.5 TENDON STRESSING

- A. Calibrate stressing jacks and gages at start of project and at least every six months thereafter. Keep copies of calibration certificates for each jack-and-gage pair on Project site that are available for inspection. Exercise care in handling stressing equipment to ensure that proper calibration is maintained.
- B. Stress tendons only under supervision of a qualified post-tensioning superintendent.
- C. Do not begin stressing operations until concrete compressive strength has reached 1500 psi (10.3 MPa)] as indicated by tests of field-cured cylinders.
- D. Complete stressing within 96 hours of concrete placement. Partial stressing to 50% of the full stressing force shall be completed within 24 hours of concrete placement.
- E. If concrete has not reached required compressive strength, obtain Architect's approval to partially stress tendons and delay final stressing until concrete has reached required strength.
- F. If detensioning and restressing of tendon is required, discard wedges used in original stressing and provide new wedges.
- G. Mark and measure elongations according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons." Measure elongations to closest 1/8 inch (3.2 mm).
- H. Submit stressing records within one day of completion of stressing. If discrepancies between measured and calculated elongations exceed plus or minus 7 percent, resolve these discrepancies to satisfaction of Architect.
- I. Prestressing will be considered acceptable if gage pressures shown on stressing record correspond to required stressing force and calculated and measured elongations agree within 7 percent.

- J. If measured elongations deviate from calculated elongations by more than 7 percent, perform additional testing, restressing, strengthening, or replacing of affected elements unless otherwise approved by Architect.

### 3.6 TENDON FINISHING

- A. Do not cut strand tails or cover anchorages until stressing records have been reviewed and approved by Architect.
- B. Cut strand tails as soon as possible after approval of elongations.
- C. Patch stressing pockets within one day of cutting strand tail. Clean inside surface of stressing pocket to remove laitance or post-tensioning coating before installing patching material. Finish patching material flush with adjacent concrete.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Before concrete placement, special inspector will inspect the following for compliance with post-tensioning installation drawings and the Contract Documents:
    - a. Location and number of tendons.
    - b. Tendon profiles and cover.
    - c. Installation of backup bars, hairpins, and other nonprestressed reinforcement shown on post-tensioning installation drawings.
    - d. Installation of pocket formers and anchorage devices.
    - e. Repair of damaged sheathing.
    - f. Connections between sheathing and anchorage devices.
  - 2. Testing agency will record tendon elongations during stressing.
  - 3. Testing agency will immediately report deviations from the Contract Documents to Architect.

### 3.8 PROTECTION

- A. Do not expose tendons to electric ground currents, welding sparks, or temperatures that would degrade components.
- B. Protect exposed components within one workday of their exposure during installation.
- C. Prevent water from entering tendons during installation and stressing.
- D. Provide weather protection to stressing-end anchorages if strand tails are not cut within 10 days of stressing the tendons.

3.9 REPAIRS

- A. Submit repair procedure to Architect for evaluation and approval.
- B. Do not proceed with repairs requiring removal of concrete unless authorized in writing by Architect.

END OF SECTION 033816

## SECTION 042200 - CONCRETE UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Pre-faced concrete masonry units.
4. Steel reinforcing bars.

#### 1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
- C. Samples: For each type and color of the following:
  1. Exposed and Decorative CMUs.
  2. Pre-faced CMUs.
  3. Pigmented and colored-aggregate mortar.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties] [material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

## 1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

### 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3,300 psi.
  - 2. Density Classification: Lightweight.

### 2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.

- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
- G. Aggregate for Mortar: ASTM C144.
  - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C404.
- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- J. Water: Potable.

## 2.4 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
  - 5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
  - 6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

## 2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

C. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

## 2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

## 2.7 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. Use Type S for all masonry.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of masonry cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
  - a. Decorative CMUs.

- b. Pre-faced CMUs.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
- 1. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Pre-faced CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C476.
- 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
  - 3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured in accordance with ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### 3.2 TOLERANCES

- A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

- B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.

3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- F. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.5 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.6 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

### 3.7 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level C in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at seven days and at 28 days.

### 3.8 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.9 MASONRY WASTE DISPOSAL

- A. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural steel.
  - 2. Shrinkage-resistant grout.

#### 1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

#### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Structural-steel materials.
  - 2. High-strength, bolt-nut-washer assemblies.
  - 3. Anchor rods.
  - 4. Threaded rods.
  - 5. Shop primer.
  - 6. Galvanized-steel primer.
  - 7. Etching cleaner.
  - 8. Galvanized repair paint.
  - 9. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Mill test reports for structural-steel materials, including chemical and physical properties.
- C. Source quality-control reports.
- D. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M-Shapes , S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

## 2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Finish: Plain.
- B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.
  - 1. Finish: Plain.
- C. Threaded Rods: ASTM A36/A36M.
  - 1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

## 2.5 PRIMER

- A. Steel Primer:
  - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: MPI#26.
  - 1. Etching Cleaner: MPI#25, for galvanized steel.
  - 2. Galvanizing Repair Paint: ASTM A780/A780M.

## 2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

## 2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

## 2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces unless indicated to be painted.
  - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  - 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

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

### 3.3 FIELD CONNECTIONS

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

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

END OF SECTION 051200

## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Roof deck.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Roof deck.

##### B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Certificates:

1. Welding certificates.
2. Product Certificates: For each type of steel deck.

##### B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

##### C. Field Quality-Control Submittals:

1. Field quality-control reports.

##### D. Qualification Statements: For welding personnel.

#### 1.4 QUALITY ASSURANCE

##### A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:
  - a. AWS D1.3/D1.3M.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

### 2.2 ROOF DECK

- A. Provide products from Vulcraft or New Millennium.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
  1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 80 (550), G90 (Z275) zinc coating.
  2. Deck Profile: As indicated.
  3. Profile Depth: As indicated.
  4. Design Uncoated-Steel Thickness: As indicated.
  5. Span Condition: Triple span or more.
  6. Side Laps: Overlapped.

### 2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- G. Galvanizing Repair Paint: ASTM A780/A780M.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

### 3.2 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
  - 1. Weld Diameter: 5/8 inch (16 mm), nominal.
  - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
  - 3. Weld Washers: Install weld washers at each weld location.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or as indicated, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 12 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
  - 1. End Joints: Lapped 2 inches (50 mm) minimum.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

### 3.3 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.
  - 2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 053100

## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof rafter framing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Cold-formed steel framing materials.
  - 2. Roof-rafter framing.
  - 3. Post-installed anchors.
  - 4. Power-actuated anchors.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each type of code-compliance certification for studs and tracks.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer.
  - 1. Steel sheet.
  - 2. Expansion anchors.
  - 3. Power-actuated anchors.
  - 4. Mechanical fasteners.
  - 5. Miscellaneous structural clips and accessories.
- D. Research Reports:
  - 1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Clark Dietrich
- B. MarinoWare

#### 2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As indicated.
  - 2. Coating: G60 (Z180).

#### 2.3 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As indicated.
  - 2. Flange Width: As indicated.

#### 2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.

## 2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure..
  - 2. Type: Torque-controlled expansion anchor.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

## 2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

## 2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

### 3.3 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated[ on Shop Drawings].
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
  - 1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on drawings. Fasten bridging at each joist intersection as follows:
  - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.

2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.4 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.5 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing agency will report test results promptly and in writing to Contractor and Architect.
- C. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

## SECTION 057300 DECORATIVE METAL RAILINGS

### PART 1- GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Component Aluminum railings
  - 2. Infill system for component aluminum railings

#### 1.2 PERFORMANCE REQUIREMENTS

- A. All railings shall be supplied to conform to applicable sections of the following codes:
  - 1. International Building Code
  - 2. NFPA
  - 3. ADAAG
- B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf. applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf. applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 3. Infill Area of Guards:
    - a. Horizontal concentrated load of 50 lbf. applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Load on infill area need not be assumed to act concurrently with loads on top rails.
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design.

- D. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- E. Qualification Data: For professional engineer.
- F. Product Test Reports: Supplier shall submit calculations and test reports for complete system, including railing and infill panels. Calculations and test reports shall be stamped by a licensed PE. Test reports shall be in accordance with ASTM E 935.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.6 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Railing Product: Subject to compliance with requirements, provide Interna-Rail® aluminum component railing as manufactured and assembled by Hollaender Manufacturing or an approved equivalent. Single source manufacturer is required. Welded railing will not be accepted.

#### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

#### 2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52, 6005-T5  
Provide 1 ½ in IPS, (1.90 in OD) Standard Weight (Schedule 40) pipe for rails, Schedule 80 for posts, Schedule 10 for pickets, unless otherwise indicated
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6061-T6.  
Provide 1 ½ in IPS, (1.90 in OD) Standard Weight (Schedule 40) pipe for rails, Schedule 80 for posts, unless otherwise indicated

- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6
- G. Base Flange Castings: ASTM B 26/B 26M, Alloy Almag 535
- H. Panel Clips and Structural Fasteners: Alloy 6063-T6.

## 2.4 STEEL

- A. Perforated Sheet: ASTM A1008.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Aluminum Railings: Alloy steel fasteners with JS-600 zinc plating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Structural Fasteners for Interconnecting Railing Components:
  - 1. Rails shall be attached to posts by means of tee fittings equipped with anodized aluminum, tubular rivet nut and stainless steel socket head cap screw. All structural fasteners such as tee fittings shall be machined from 6063-T6 aluminum alloy. The fitting shall be internally connected to the rail by means of an internal dual tang that is expanded with a stainless steel, internal /external, reverse knurl, cup point socket head set screw. This combination shall prevent any loosening of the system due to changes in temperature or vibration. Systems using pop rivets or adhesives will not be accepted.
- D. Fasten infill panels to rails and posts with Hollaender model 145 panel clips, machined from 6063-T6 aluminum alloy. Secure the infill panels in the panel clips with reverse-knurl cup-point set screws. Fasten panel clips to rails and posts with ¼ - 20 sheet metal screws.
- E. Anchors: Provide concrete adhesive anchors where indicated or necessary.

## 2.6 INFILL FOR RAILINGS

- A. Panel:
  - 1. Woven Aluminum Wire Mesh infill panel: minimum .250 in dia, aluminum alloy A1350-H9.
  - 2. Pattern: 2" square.
  - 3. Frame: aluminum U-channel, minimum 11 ga, x 1 in, corners welded and ground smooth. To assure minimum maintenance and maximum corrosion protection, bottom channel of frame shall have 3 drainage holes to evacuate water.
  - 4. Coating
    - a. Entire panel shall be powder coated with Silver powder coat, or equivalent powder coat color of architect's choice. Powder to be TGIC Polyester, minimum AAMA 2604.
  - 5. Panels to be attached to railing using Hollaender #145 panel retainers and ¼ - 20 screws, with appropriate slot width for panel thickness, and set screw for final tightening of panel within retainer slot.

## 2.7 HANDRAIL FOR STAIRS

- 1. Ramps that have a drop off of 30 inches or more on the side require guardrail, per above spec. Ramps with a rise greater than 6 inches shall have handrails on both sides.
- 2. Stairways shall have handrails on both sides.

3. Handrail will be attached to the guardrail sections using Hollaender model 85 adjustable brackets.
4. Handrail will be installed at a height of 34 – 38 inches above ramp surface or stair tread nosings.
5. Handrail will be anodized aluminum 6063 Sch. 40, 1 ½ in IPS nominal (1.90 in. OD) and shall have a continuous surface. Where necessary, lengths of the handrail will be spliced using Hollaender Model 70ES-8 internal locking splices.
6. Handrails shall return to a wall, guard or walking surface. If returning to the guard, Hollaender model 185 post return swivel shall be used to connect the end of the handrail to the guardrail post.

## 2.8 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.9 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items. Welding will not be accepted.
- G. Connections: Fabricate railings with non-welded connections, unless otherwise indicated. Welding will not be accepted.
- H. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  1. Fittings to be of the internal double tang type activated by a reverse knurl cup point set screw. Reverse knurl is required to ensure that screw does not come loose under vibration. Plain cup point screws will not be accepted. Fittings to be fastened to pipe by means of a 5/16 in. tubular rivet nut and socket head cap screw.
- I. Form changes in direction as follows:
  1. By flush bends or by inserting prefabricated flush-elbow fittings.
- J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated. Flanges to be sand cast

from aluminum alloy 535 with anodized finish and fastened directly to the post by means of two reverse knurl cup point set screws.

- N. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

## 2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.11 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Unless indicated otherwise, provide aluminum pipe with the following finish:
  - 1. Anodized Finish: AA-M10C22A41 (Architectural class, .7 mil thickness or greater)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Non-welded Connections: Use mechanical joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

### 3.4 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using non-welded connections.

### 3.5 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as indicated, or if not indicated, as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. Provide blocking between studs in stud wall construction.

### 3.6 ADJUSTING AND CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

### 3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION - 057300 DECORATIVE METAL RAILINGS

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Framing with dimension lumber.
  2. Rooftop equipment bases and support curbs.
  3. Wood blocking and nailers.
  4. Wood furring.
  5. Wood sleepers.
  6. Interior wood trim.
  7. Wood shelving and clothes rods.
  8. Plywood backing panels.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Include data for wood-preservative and fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Preservative-treated wood.
  2. Fire-retardant-treated wood.
  3. Power-driven fasteners.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  3. Provide dressed lumber, S4S, unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawl spaces or unexcavated areas.
  - 5. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPAC27 (plywood).
  - 1. Use Interior Type A, unless otherwise indicated.
- B. Application: Treat items indicated on Drawings, and the following:
  - 1. Plywood backing panels (Telephone and electrical backer boards).

## 2.4 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 19 percent.
- B. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.
- C. Other Framing: Construction or No. 2 grade and any of the following species:
  - 1. Southern pine; SPIB.
  - 2. Mixed southern pine; SPIB.
  - 3. Douglas fir-south; WWPA.
  - 4. Hem-fir; WCLIB or WWPA.
  - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

## 2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Equipment bases and support curbs.
  - 4. Furring.
  - 5. Grounds.
  - 6. Utility shelving.
- B. For items of dimension lumber size, provide Construction or No. 2, Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content of any species.
- C. For exposed boards, provide lumber with 15 percent maximum moisture content of eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
  - 1. Mixed southern pine, No. 2 or 3 grade; SPIB.
  - 2. Eastern softwoods, No. 2 or 3 Common grade; NELMA.
  - 3. Northern species, No. 2 or 3 Common grade; NLGA.

## 2.6 INTERIOR WOOD TRIM

- A. General: Provide kiln-dried finished (surfaced) material without finger-jointing, unless otherwise indicated.
- B. Hardwood Lumber Trim for Transparent (Stain or Clear) Finish: Clear red oak or white maple, selected for compatible grain and color.
- C. Lumber Trim for Opaque (Painted) Finish: Either finger-jointed or solid lumber, of one of the following species and grades:
  - 1. Grade D Select or Premium eastern white pine; NeLMA or NLGA.
- D. Moldings: Made to patterns included in WMMPA WM 7 and graded according to WMMPA WM 4.
  - 1. Moldings for Transparent (Stain or Clear) Finish: N-grade eastern white, Idaho white, lodgepole, ponderosa, alder, or sugar pine.
  - 2. Moldings for Opaque (Painted) Finish: P-grade eastern white, Idaho white, lodgepole, ponderosa, or sugar pine aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar primed medium-density fiberboard.

## 2.7 SHELVING AND CLOTHES RODS

- A. Shelving: Made from the following material, **3/4-inch (19-mm)** thick.
  - 1. Wood boards of same species and grade indicated above for interior lumber trim for opaque finish.
- B. Shelf Cleats: **3/4-by-5-1/2-inch (19-by-140-mm)** boards with hole and notch to receive clothes rods, of same species and grade indicated above for interior lumber trim for opaque finish.
- C. Clothes Rods: **1-1/2-inch- (38-mm-)** diameter, clear, kiln-dried hardwood rods.

## 2.8 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than **3/4-inch** nominal thickness.

## 2.9 FASTENERS

- A. General: Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
- B. Power-Driven Fasteners: NES NER-272.
- C. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports, unless otherwise indicated.
- D. Comply with AWPAM4 for applying field treatment to cut surfaces of preservative-treated lumber.
- E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
  2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  3. Refer to the Structural drawings and specifications for additional requirements and fasteners.
- F. Wood Trim Installation: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.
1. Match color and grain pattern across joints.
  2. Install trim after gypsum board joint-finishing operations are completed.
  3. Install to tolerance of **1/8 inch in 96 inches (3 mm in 2438 mm)** for level and plumb. Install adjoining finish carpentry with **1/32-inch (0.8-mm)** maximum offset for flush installation and **1/16-inch (1.6-mm)** maximum offset for reveal installation.

### 3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

## SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets that are not concealed within other construction.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

##### B. Shop Drawings: For plastic-laminate-faced architectural cabinets.

1. Include plans, elevations, sections, and attachment details.

##### C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 QUALITY ASSURANCE

- ##### A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

### PART 2 - PRODUCTS

#### 2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- ##### A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.

- ##### B. Grade: Custom.

- C. Type of Construction: Frameless
- D. Door and Drawer-Front Style: Full Overlay.
- E. High-Pressure Decorative Laminate:
  - 1. refer to Section 060513 Decorative Plastic Laminate Finishes for selections
- F. Laminate Cladding for Exposed Surfaces:
  - 1. refer to Section 060513 Decorative Plastic Laminate Finishes for selections
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces:
  - 1. refer to Section 060513 Decorative Plastic Laminate Finishes for selections
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

## 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 4 to 9 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, minimum 120 degrees of opening.
  - 1. Heavy Duty
  - 2. Three way adjustable, with screw.
  - 3. Full overlay application (frameless cabinetry)
  - 4. With Spring
  - 5. Nickel plated.
- C. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: BHMA A156.9, B04013; metal.

- G. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.
    - a. Type: Full extension.
    - b. Material: Zinc-plated steel with polymer rollers.
  2. Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-200.
  4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-200.
  5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
  6. For computer keyboard shelves, provide Grade 1HD-200.
  7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-200.
- H. Slides for Sliding Glass Doors: BHMA A156.9, B07063; aluminum.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Door and Drawer Silencers: BHMA A156.16, L03011.
- L. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Color: to be selected by the Interior Designer from the MFG's full range of colors.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA, to be selected by the Architect from the following options:
1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
  2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
  3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
  4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
  5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
  6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
  7. Satin Stainless Steel: BHMA 630.
  8. Nickel-Plated
  9. Satin Finish, stainless steel
- N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
  - 1. For glass in frames, secure glass with removable stops.
  - 2. For exposed glass edges, polish and grind smooth.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)** using concealed shims.
  - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

END OF SECTION 064116

**Part 1 - General****1.01 SCOPE**

The work covered by this section of the specification includes supplying and installing loose-fill material for the thermal insulation of all masonry walls in accordance with these specifications and applicable drawings.

**Part 2 - Products****2.01 MATERIALS**

Perlite loose-fill insulation. Each package shall be clearly marked as such. The insulation material should conform to the requirements of ASTM Designations C549. Prior to installation of the insulation, the manufacturer should furnish a certificate to the architect or owner stating that the product conforms to the Standard Specifications for Loose-Fill Insulation as adopted and published by the Perlite Institute, Inc.

**Part 3 - Execution****3.01 INSTALLTION**

(a) The insulation must be installed in the following locations:

- In the cores of all exterior (and interior) hollow masonry units.

(b) The insulation shall be poured directly into the wall at any convenient internal. Wall sections under doors and windows shall be filled before sills are placed. Rodding or tamping is not necessary.

(c) All holes and opening in the wall through which insulation can escape shall be permanently sealed or caulked prior to installation of the insulation. Copper, galvanized steel, or fiberglass screening shall be used in all weep holes. (The inclusion of weep holes is considered good construction design practice to allow passage of any water that might penetrate the cavities or core spaces of wall construction.)

(d) Insulation must remain dry. Cavity caps or other suitable means should be used as the work progresses to insure that the insulation is protected from inclement weather.

## SECTION 072119 - FOAMED-IN-PLACE INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Open-cell spray polyurethane foam.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

### PART 2 - PRODUCTS

#### 2.1 OPEN-CELL SPRAY POLYURETHANE FOAM

- A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of **0.4 lb/cu. ft. (6.4 kg/cu. m)** and minimum aged R-value at **1-inch (25.4-mm)** thickness of **3.4 deg F x h x sq. ft./Btu at 75 deg F (24 K x sq. m/W at 24 deg C)**.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle Spray Foam Insulation.
    - b. Henry Company.
    - c. Johns Manville; a Berkshire Hathaway company.
  - 2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 3. Fire Propagation Characteristics: Passes NFPA 285 and NFPA 276 testing as part of an approved assembly.

2.2 Thermal / Ignition barrier

- A. Provide additional Thermal / Ignition Barrier (as required by Code).
  - 1. Installer shall provide barrier that shall satisfy all code requirements for all the applications and locations this project.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 072119

## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Standing-seam metal roof panels.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Twenty (20) years from date of Substantial Completion.
- B. Contractor shall provide Two (2) year Contractor warranty:
  - 1. The Contractor has contracted to guarantee said work against water entry from faulty or defective materials and workmanship for the designated Guarantee period of TWO (2) YEARS from the date of the Final acceptance of the Project;
  - 2. The Contractor guarantees, subject to the terms and conditions herein set forth, that during the Guarantee Period the Contractor will at his own cost and expense, make or cause to be made with approved procedures and materials such repairs to or replacements of said work (including any wetted thermal insulation) resulting from water entry or faults or defects of said Work as are necessary to maintain said Work in watertight conditions and further, respond on or within TWO (2) working days upon written notification of leaks or defects by the Owner/User Agency.
- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E1680.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.

- E. Hail Resistance: Class 4
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
  - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
  - 3. Manufacturers: Subject to compliance with requirements, provide one of the following products:
    - a. Berridge MFG Co.
      - 1) Approved product: (Double-Lock Zee-Lock Panel, 16" Striated 24 GA)
    - b. McElroy Metal.
      - 1) Approved Product (Maxima, 16" Striated 24 GA)
    - c. PAC-Clad Peterson
      - 1) (Tite-Loc Plus, 16" Striated 24 GA)
    - d. MBCI
      - 1) (Battenlok HS, 16" Striated 24 GA)
    - e.
  - 4.
- B. Subject to compliance with requirements provide one of the Manufactured listed products.
  - 1. Substitution Limitations:
    - a. Requests for approval must be submitted in writing at least ten (10) days prior to bid date, and are accompanied by all related test reports and design calculations listed in section 1.4 and Design and Performance criteria Section 2.2.
    - b. Substitute manufacturers will be approved by written addendum to all bidders. Voluntary alternates will not be considered. Substitutions will not be permitted after the bid date of this project.
    - c. Roof panels proposed for substitution shall fully comply with specified requirements in appearance, assembly, and performance.
- C. Standing Seam Roof Panels:
  - 1. Profile: Vertical leg standing seam panel with male/female seam to be mechanically interlocked at jobsite with mechanical seamer specifically designed for Maxima profile.

2. Specifier Note: Edit paragraph below. 16" (406 mm) panel is inventoried; other widths are optional.
  3. Size: 2" high seam by 16" width, Length as indicated on drawings.
  4. Panel Surface: 2": Striated
  5. Material: Galvalume steel sheet conforming to ASTM A792, AZ50 coating for bare; AZ50 coating for painted; 24 gauge sheet thickness.
  6. Panels should be factory formed for lengths below 50'. To avoid lap conditions for panels greater than 50', panels should be produced on site but production must be completed by factory technicians.
  7. Color: As selected by Architect from manufacturer's full range.
- D. Panel Clips: ASTM A 653/A 653M, **G90 (Z180)** hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- E. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.
- F. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
  2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
  3. Concealed Joint Sealant: Non-curing butyl, AAMA 809.2.
- G. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, **G60 (Z180)** hot-dip galvanized zinc coating.
- H. Roof Accessories: Approved by metal roof panel manufacturer. Refer to [Section 07 72 00] "Roof Accessories" for requirements for roof accessories.
- I. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of **30 mils (0.76 mm)** thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at **240 deg F (116 deg C)**; ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus **20 deg F (29 deg C)**; ASTM D1970.
  3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [ATAS International, Inc.](#)
    - b. [Carlisle WIP Products; a brand of Carlisle Construction Materials.](#)
    - c. [Owens Corning.](#)
    - d. [Polyglass U.S.A., Inc.](#)

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, **G90 (Z275 hot-dip galvanized)** coating designation or ASTM A792/A792M, **Class AZ50 (Class AZM150)** coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels.
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
  - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same

profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.5 FINISHES

### A. Panels and Accessories:

1. Kynar 500 (PVDF)
2. Two-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.
3. Concealed Finish: White or light-colored acrylic or polyester backer finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install sub framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

### 3.2 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  4. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.

- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

### 3.3 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16

## SECTION 074213.13 - Formed Metal Wall Panels

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Formed Metal Wall Panels
  - a. (Also approved for use for Ceiling locations at pickleball court PEMB Structures only)

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 20 years from date of Substantial Completion.

- B. Contractor shall provide Two (2) year Contractor warranty:
1. The Contractor has contracted to guarantee said work against water entry from faulty or defective materials and workmanship for the designated Guarantee period of TWO (2) YEARS from the date of the Final acceptance of the Project;
  2. The Contractor guarantees, subject to the terms and conditions herein set forth, that during the Guarantee Period the Contractor will at his own cost and expense, make or cause to be made with approved procedures and materials such repairs to or replacements of said work (including any wetted thermal insulation) resulting from water entry or faults or defects of said Work as are necessary to maintain said Work in watertight conditions and further, respond on or within TWO (2) working days upon written notification of leaks or defects by the Owner/User Agency.
- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
  3. Deflection Limits: For wind loads, no greater than as indicated on Drawings of the span.
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E283 at the following test-pressure difference:
1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

2.2 FORMED METAL WALL PANELS (Also approved for use for Ceiling locations at pickleball court PEMB Structures only)

- A. Provide FORMED METAL WALL PANELS designed to be installed by lapping and interconnecting side edges of adjacent panels
- B. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by metal panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating
- C. FORMED METAL WALL PANELS: Basis of design: McElroy Metal, R-Panel, 36" wide, non-vented, standard rib pattern, 24 ga, min. two coat Kynar 500 finish, standard 24 ga galvalume substrate.
  - 1. Finish: to be selected by the Architect from the Manufacturers full line of standard colors.
  - 2. Sealant: Factory applied within lap joint.
  - 3. Profile: Major longitudinal ribs 1 1/4" (32 mm) deep, spaced 12" (305 mm) on center; minor longitudinal ribs centered between major ribs, spaced 4" (102 mm) on center panel; normal-run where ribs protrude from panel plane, viewed from exterior, reverse-run where ribs recede from panel plane, viewed from exterior.
  - 4. Size: 36" (914 mm) cover width, lengths indicated on drawings.
  - 5. Material: Galvalume steel sheet conforming to ASTM A792, AZ55 coating for bare; AZ50 coating for painted; 24 gauge sheet thickness.

2.3 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closure Strips (Concealed): Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum ~~1-inch~~ (25-mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- D. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Contractor may choose On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.5 FINISHES

- A. Panels and Accessories:
  1. Two coat Kynar 500 finish.
  2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install sub framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
  1. Soffit Framing: fasten furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.2 INSTALLATION

- A. FORMED METAL WALL PANELS: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

### 3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

## SECTION 074293 - SOFFIT PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal soffit panels

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

- ##### B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

- ##### C. Samples: For each type of metal panel indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- ##### A. Product test reports.

- ##### B. Warranties: Samples of special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- ##### A. Maintenance data.

#### 1.6 WARRANTY

- ##### A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than as indicated on Drawings of the span.
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.

### 2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Basis of design: McElroy Metal, Marquee-Lok Ribs, 12" wide, non-vented, single pencil rib, 24 ga, min. two coat Kynar 500 finish, standard 24 ga galvalume substrate.
  - 1. Finish: to be selected by the Architect from the Manufacturers full line of standard colors.
  - 2. Sealant: Factory applied within interlocking joint.

## 2.3 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closure Strips (Concealed): Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum ~~1-inch~~ (25-mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- D. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; ~~1/8 inch~~ (3 mm) thick.
  - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Contractor may choose On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.5 FINISHES

### A. Panels and Accessories:

1. Two coat Kynar 500 finish.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

#### A. Miscellaneous Supports: Install sub framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: fasten furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.2 INSTALLATION

#### A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

#### B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

#### C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

### 3.3 CLEANING

#### A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

- ##### B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

- ##### C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- ##### A. Product certificates.

- ##### B. Product test reports.

- ##### C. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- ##### A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
  - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof edge eave, including fascia fascia trim and gutter profile, approximately 12" minimum long.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation, **Grade 40 (Grade 275)**; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color: As selected by Architect from manufacturer's full range.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum **30 mils (0.76 mm)** thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer. (Provide granular surface or Red Rosin slip sheet where required by roofing manufacturer)
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [Carlisle Coatings & Waterproofing Inc.](#)
    - b. [Carlisle WIP Products; a brand of Carlisle Construction Materials.](#)
    - c. [Owens Corning.](#)
  - 2. Thermal Stability: ASTM D 1970; stable after testing at **240 deg F (116 deg C)** or higher.
  - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus **20 deg F (29 deg C)** or lower.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- 2.5 MANUFACTURED REGLETS
- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Fry Reglet Corporation.](#)
    - b. [Heckmann Building Products, Inc.](#)
    - c. [Keystone Flashing Company, Inc.](#)
  2. Material: Aluminum, **0.024 inch (0.61 mm)** thick.
  3. Finish: Mill With manufacturer's standard color coating.

## 2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 1. Obtain field measurements for accurate fit before shop fabrication.
  - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum **96-inch- (2400-mm-)** long sections. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

1. Hanger Style: .
2. Fabricate from the following materials:
  - a. Aluminum: 0.024 inch (0.61 mm) thick.

## 2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
  1. Aluminum-Zinc Alloy-Coated Steel: 24 gauge thick.
- B. Drip Edges: Fabricate from the following materials:
  1. Aluminum-Zinc Alloy-Coated Steel: 24 gauge thick unless indicated in the drawings.
- C. Eave, Rake Flashing: Fabricate from the following materials:
  1. Aluminum-Zinc Alloy-Coated Steel: 24 gauge thick unless indicated in the drawings.

## 2.9 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - a. Prefinished Aluminum: 0.036 inch (20 ga) thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
  - a. Prefinished Aluminum: 0.036 inch (20 ga) thick.

## PART 3 - EXECUTION

### 3.1 UNDERLAYMENT INSTALLATION

- A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than **12 inches (300 mm)** apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of **10 feet (3 m)** with no joints within **24 inches (600 mm)** of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated, but not exceeding, **50 feet (15.24 m)** apart. Install expansion-joint caps.
- C. Downspouts: Join sections with **1-1/2-inch (38-mm)** telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately **60 inches (1500 mm)** o.c.
- D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of **4 inches (100 mm)** in direction of water flow.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of **4 inches (100 mm)** over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing **4 inches (100 mm)** over base flashing. Lap counterflashing joints minimum of **4 inches (100 mm)**.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with [**elastomeric**] [**butyl**] sealant and clamp flashing to pipes that penetrate roof.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

### 3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814:
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  - 2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
  - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

## 1.4 QUALITY ASSURANCE

- A. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- B. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
- C. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated on Drawings, that are produced by one of the following manufacturers:
  - 1. A/D Fire Protection Systems Inc.
  - 2. Grace, W. R. & Co. - Conn.
  - 3. Hilti, Inc.
  - 4. Johns Manville.
  - 5. Nelson Firestop Products.
  - 6. NUCO Inc.
  - 7. RectorSeal Corporation (The).
  - 8. Specified Technologies Inc.
  - 9. 3M; Fire Protection Products Division.
  - 10. Tremco; Sealant/Weatherproofing Division.
  - 11. USG Corporation.

### 2.2 FIRESTOPPING

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

## PART 3 - EXECUTION

### 3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after installations comply with requirements.

END OF SECTION 078413

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes joint sealants for the following applications:
  - 1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
  - 2. Interior joints in vertical surfaces and horizontal non-traffic surfaces.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

#### 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required.
- C. Product certificates and test reports.

#### 1.4 QUALITY ASSURANCE

- A. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

#### 1.5 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 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.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Available Products:
  - a. Bostik Findley.
  - b. Dow Corning Corporation.
  - c. GE Silicones.
  - d. Pecora Corporation.
  - e. Polymeric Systems Inc.
  - f. Schnee-Morehead, Inc.
  - g. Sonneborn, Division of ChemRex Inc.
  - h. Tremco.

### 2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
    - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 2. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
  
- C. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  
- D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
  
- E. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. standard steel doors and frames.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### 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. Airtec Corporation.
  - 2. Apex Industries, Inc.
  - 3. Ceco Door; ASSA ABLOY.

4. [Curries Company; ASSA ABLOY.](#)
5. [Republic Doors and Frames.](#)
6. [West Central Manufacturing, Inc.](#)

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

## 2.3 STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
  1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Metallic-coated steel sheet, minimum thickness of 16 ga. with minimum A40 (ZF120) coating.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of doors to permit moisture to escape.
    - g. Core: Polystyrene.
    - h. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
  2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 16 ga., with minimum A40 (ZF120) coating.
    - b. Construction: Full profile welded.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
  3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.6 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Hollow-Metal Frames: Comply with NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  2. Fire-Rated Openings: Install frames according to NFPA 80.
  3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  4. Solidly pack mineral-fiber insulation inside frames.
  5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

## SECTION 083313 - COILING COUNTER DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Counter door assemblies.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for door-opening framing and corner guards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 2. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

## PART 2 - PRODUCTS

### 2.1 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ACME Rolling Doors.
    - b. C.H.I. Overhead Doors, Inc.
    - c. City Gates USA.
    - d. Lawrence Doors; by Amarr.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.
- C. Door Curtain Material: Aluminum.
- D. Door Curtain Slats: Flat profile slats of 1-1/2-inch (38-mm) center-to-center height.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished.
- F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Match curtain material and finish.
  - 1. Mounting: Between jambs As indicated on Drawings.
- H. Sill Configuration: No sill.
- I. Locking Devices: Equip door with locking device assembly.
  - 1. Locking Device Assembly: Cremona-type, both jamb sides locking bars, operable from inside with thumbturn.
- J. Manual Door Operator: Push-up operation.
- K. Curtain Accessories: Equip door with weatherseals push/pull handles, with either pull-down strap or pole hook.
- L. Door Finish:
  - 1. Aluminum Finish: Mill.

## 2.2 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.3 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

## 2.5 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: As standard with manufacturer and keyed to building keying system.
  - 2. Keys: Three for each cylinder.
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.6 CURTAIN ACCESSORIES

- A. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

- C. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.
- D. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

## 2.7 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

### 3.2 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

### 3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

## SECTION 083613 - SECTIONAL DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sectional-door assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design" applicable to sectional doors.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

[Verify available warranties and warranty periods.](#)

- 1. Warranty Period: Five years from date of Substantial Completion.

- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: In accordance with ASTM E330/E330M or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria.

### 2.2 SECTIONAL-DOOR ASSEMBLY

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C.H.I. Overhead Doors, Inc.
    - b. Martin Door Manufacturing.
    - c. Overhead Door Corporation.
    - d. Raynor Garage Doors.
- B. Operation Cycles: Door components and operators capable of operating for not less than 25,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of **0.4 cfm/sq. ft. (2.03 L/s per sq. m)** when tested in accordance with ASTM E283 or DASMA 105.
- D. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with **G90 (Z275)** zinc coating.
  - 1. Door-Section Thickness: **2 inches (51 mm)**.
  - 2. Section Faces:

Retain "Thermal-Break Construction" Subparagraph below if required for insulated doors.

- a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
  - b. Exterior Face: Fabricated from single sheets, not more than 24 inches (610 mm) high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
    - 1) Steel Sheet Thickness: 0.028-inch (0.71-mm) nominal coated thickness.
    - 2) Surface: Manufacturer's standard, ribbed.
  - c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
    - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.022 inch (0.56 mm).
3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch (1.63-mm) nominal coated thickness and welded to door section.
- a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
  - b. Hardware Locations: Provide reinforcement for hardware attachment.
4. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:
- a. Board Insulation: Polystyrene, secured to exterior face sheet.
  - b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
  - c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- E. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
- 1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 (Z180) zinc coating.
  - 2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
  - 3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.
- F. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide bottom weatherseal for bottom seal.

- G. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
1. Hinges: Heavy-duty, galvanized-steel hinges of not less than **0.079-inch (2.01-mm)** nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
  2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Neoprene or bronze.
  3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.
- H. Locking Device:
1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from the exterior.
- I. Counterbalance Mechanism:
1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
  2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
    - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
  3. Cables: Galvanized-steel, multistrand, lifting cables.
  4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
  5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
  6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- J. Manual Door Operator:
1. Push-Up Operation: Lift handles and pull rope for raising and lowering doors located on inside and outside of bottom section; with counterbalance mechanism designed so that required lift or pull for door operation does not exceed **25 lbf (111 N)**.
- K. Metal Finish:

1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range, including manufacturer's premium colors.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than **24 inches (610 mm)** apart.
  2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

### 3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Exterior storefront framing.
2. Exterior manual-swing entrance doors.

#### 1.2 PERFORMANCE REQUIREMENTS

##### A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
  - a. Deflection exceeding specified limits.
  - b. Thermal stresses transferring to building structure.
  - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
  - d. Noise or vibration created by wind and by thermal and structural movements.
  - e. Loosening or weakening of fasteners, attachments, and other components.
  - f. Failure of operating units.

##### B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

##### C. Wind Loads: As indicated on Drawings.

##### D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or **1/8 inch (3.2 mm)**, whichever is smaller.

##### E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **0.06 cfm/sq. ft. (0.03 L/s per sq. m)** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **1.57 lbf/sq. ft. (75 Pa)**.

- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Samples: For each type of exposed finish required.
- D. Other Action Submittals:
  - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Product test reports.
- G. Maintenance data.
- H. Warranties: Sample of special warranties.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. 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.
- D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

- E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at Project site.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: five years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## 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. United States Aluminum.
  - 2. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
  - 4. Structural Profiles: ASTM B 308/B 308M.
  - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: 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 according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.

3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

## 2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware sets indicated in door hardware schedule for each entrance door and to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, of manufacturers' products.
  2. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
- B. Opening-Force Requirements:
  1. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- C. Pivot Hinges: BHMA A156.4, Grade 1.
  1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- G. Cylinders: As specified in Division 08 Section "Door Hardware."
  1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation.
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: BHMA A156.6.
- J. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- K. Weather Stripping: Manufacturer's standard replaceable components.

- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- M. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
- N. Egress windows: provide manufacturer's standard code compliant hardware at all bedroom egress windows.
  - 1. Latches and opening hardware shall meet all code requirements.
  - 2. Clear opening, including hardware shall meet all code requirements. Contractor and supplier shall confirm opening requirements prior to ordering and shall be indicated on submittal to Architect.

## 2.7 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. Framing Members, General: 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. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from interior.
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: As selected by Architect from full range of industry colors and color densities (including Clear, Dark Bronze and Black anodized colors).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
  - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

END OF SECTION 084113

## **SECTION 087100 - DOOR HARDWARE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Commercial door hardware.

#### **1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Other Action Submittals:
  - 1. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks.

#### **1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  - 1. Test Pressure: Test at atmospheric pressure.

#### **1.4 COORDINATION**

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

#### **1.5 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware schedule indicated in door schedule.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function to hardware sets indicated in door schedule.

### 2.2 HINGES, GENERAL

- A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Hinge Base Metal: Unless otherwise indicated, provide the following:
  - 1. Exterior Hinges: Stainless steel, with non removable stainless-steel pin.
  - 2. Interior Hinges: Steel, with steel pin.
  - 3. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
- C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
- D. Fasteners: Comply with the following:
  - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
  - 2. Wood Screws: For wood doors and frames.
  - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
  - 4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

### 2.3 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
  - 1. Levers
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

- E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

## 2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
  - 1. Mortise Locks: BHMA A156.13.
- B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1.

## 2.5 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.
  - 1. Match design for locksets and latchsets, unless otherwise indicated.
- F. Through Bolts: For exit devices and trim on metal doors and fire-rated wood doors.

## 2.6 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
  - 1. Number of Pins: Five.
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.
- D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

## 2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.
- B. Keys: Nickel silver.
  1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five master keys.

## 2.8 CLOSERS

- A. Accessibility Requirements: Comply with the following maximum opening-force requirements:
  1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
  2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
  3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- C. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.
- D. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.
- E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- F. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

## 2.9 STOPS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
  1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

## 2.10 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
  - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
  - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

## 2.11 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

## 2.12 FABRICATION

- A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.
- C. Finishes: BHMA A156.18, as indicated in door hardware sets.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.
- C. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- F. 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: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

### 3.2 DOOR HARDWARE SETS

- A. The hardware sets below shall be the Basis of design. The Contractor shall provide the hardware listed below, or approved equal :

## Hardware Schedule

### Heading #SET#01

1 Single door 301A

1 Single door 302A

36" x 84" x \_\_ - HM DR x HM FR

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6	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652 NRP	652
2	Exit Device	Von Duprin 98-L-NL-630-36" x 84" Door -LH-996L-NL-R/626	630/626
2	Surface Closer	LCN 4040XP RWPA 689 LH	689
2	Floor Door Stop	Ives FS18S	
2	Threshold	Zero 65A 36"	A
2	Gasketing	Zero 142AA 40"	AA
2	Gasketing	Zero 328AA 36" x 84"	AA
2	Gasketing	Zero 8198AA 36"	AA

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### Heading #SET#02

1 Single door 111A

1 Single door 305A

36" x 84" x \_\_ - HM DR x HM FR

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6	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652 NRP	652
2	Lockset	Schlage ND80 P6 RHO 626	626
2	Kick Plate	Ives 8400 US32D B-CS 10" x 34"	US32D
2	Overhead Door Stop	Glynn-Johnson 904S US32D	US32D
2	Gasketing	Zero 328AA 36" x 84"	AA
2	Gasketing	Zero 8198AA 36"	AA

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Heading #SET#03

1 Single door 109A

1 Single door 110A

36" x 84" x \_\_ - HM DR x HM FR

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6	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652	652
2	Latchset	Schlage ND10 RHO 626	626
2	Surface Closer	LCN 4040XP RWPA 689 LH	689
2	Kick Plate	Ives 8400 US32D B-CS 10" x 34"	US32D
2	Kick Plate	Ives 8400 US32D B-CS 4" x 35"	US32D
2	Floor Door Stop	Ives FS18S	
2	Threshold	Zero 65A 36"	A
2	Gasketing	Zero 142AA 40"	AA
2	Gasketing	Zero 328AA 36" x 84"	AA
2	Gasketing	Zero 8198AA 36"	AA

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Heading #SET#04

1 Single door 102A

1 Single door 103A

1 Single door 104A

1 Single door 112A

1 Single door 113A

36" x 84" x \_\_ - HM DR x HM FR

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15	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652 NRP	652
5	Lockset	Schlage ND80 P6 RHO 626	626
5	Overhead Door Stop	Glynn-Johnson 904S US32D	US32D

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Heading #SET#05

- 1 Single door 105A
- 1 Single door 106A
- 1 Single door 107A
- 1 Single door 303A

36" x 84" x \_\_ - HM DR x HM FR

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12	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652 NRP	652
4	Lockset	Schlage ND50 P6 RHO 626	626
4	Overhead Door Stop	Glynn-Johnson 904S US32D	US32D

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Heading #SET#06

- 1 Single door 108A

36" x 84" x \_\_ - HM DR x HM FR

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3	Standard Hinge	Ives 5BB1 4 1/2" x 4 1/2" 652	652
1	Lockset	Schlage ND40 RHO 626 OS-OCC	626
1	Surface Closer	LCN 4040XP RWPA 689 LH	689
1	Kick Plate	Ives 8400 US32D B-CS 10" x 34"	US32D
1	Kick Plate	Ives 8400 US32D B-CS 4" x 35"	US32D
1	Wall Door Stop	Ives WS406/407CCV US32D	US32D

END OF SECTION 087100

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Windows.
  - 2. Storefront framing.
  - 3. Glazed entrances.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

#### 1.3 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

#### 1.4 QUALITY ASSURANCE

- A. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass 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 on Insulating Glass: Manufacturer's standard form in which 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 the 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 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. 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: shall meet or exceed current adopted energy code requirements.
2. Solar Heat-Gain Coefficient and Visible Transmittance: shall meet or exceed current adopted energy code requirements.
3. Visible Reflectance: shall meet or exceed current adopted energy code requirements.

### 2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I () unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

## 2.3 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal.
  2. Spacer: Manufacturer's standard spacer material and construction.

## 2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. Neoprene complying with ASTM C 864.
  2. EPDM complying with ASTM C 864.
  3. Silicone complying with ASTM C 1115.
  4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

## 2.5 INSULATING-GLASS TYPES

- A. Glass Type : Low-e-coated, tinted insulating glass.
1. Overall Unit Thickness:
    - a. Storefront frame and entrance doors: 1 inch (25 mm).
    - b. Aluminum operable windows: 5/8 inch (16 mm).
  2. Thickness of Each Glass Lite:
    - a. Storefront frame and entrance doors: 6.0 mm.
    - b. Aluminum operable windows: 4.0 mm.
  3. Outdoor Lite:
    - a. Store front and entrance doors: Refer to window types for designated locations for fully tempered float glass.
    - b. Aluminum operable windows: Heat-strengthened float glass.
  4. Interspace Content: Air.
  5. Indoor Lite:
    - a. Store front and entrance doors: Refer to window types for designated locations for fully tempered float glass.
    - b. Aluminum operable windows: Heat-strengthened float glass.
  6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
  7. Visible Light Transmittance: 0.70 percent minimum.
  8. U-Factor: shall meet or exceed current adopted energy code requirements.

9. Solar Heat Gain Coefficient: shall meet or exceed current adopted energy code requirements.
10. Provide safety glazing labeling.

## 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 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 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 by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.3 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

#### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

#### 1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### PART 2 - PRODUCTS

#### 2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Gypsum Co.
  - b. BPB America Inc.
  - c. G-P Gypsum.

- d. Lafarge North America Inc.
- e. National Gypsum Company.
- f. PABCO Gypsum.
- g. Temple.
- h. USG Corporation.

B. Type X:

- 1. Thickness: **5/8 inch (15.9 mm)**.
- 2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

- 1. Core: **5/8 inch (15.9 mm)**, Type X.
- 2. Long Edges: Tapered.

## 2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- 2. Shapes: Verify with Architect (not all indicated may be used)
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.
  - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - f. Expansion (control) joint.
  - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.3 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

- 1. Interior Gypsum Wallboard: Paper.
- 2. Exterior Gypsum Soffit Board: Paper.
- 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- 4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
- 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping drying-type, all-purpose compound.
4. Finish Coat: For third coat, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

### 3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
  - 2. Moisture- and Mold-Resistant Type: at all bathrooms and exterior unconditioned spaces, (Type-X where fire rating is required).

### 3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect. Use Clark Dietrich, vinyl 093 control joint, or approved equal at a maximum of 30'-0" o.c., and as indicated in the drawings.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. L-Bead: Use where indicated.
  - 4. U-Bead: Use at exposed panel edges.
  - 5. Curved-Edge Cornerbead: Use at curved openings.

### 3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 4: All interior walls.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5 APPLYING TEXTURE FINISHES (texture to be selected by the Architect from the manufacturers full range.

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 095123 - ACOUSTICAL TILE CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Acoustical tiles.
  - 2. Metal suspension system.
  - 3. Accessories.
  - 4. Metal edge moldings and trim.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.
- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A in accordance with ASTM E1264.
  - 2. Smoke-Developed Index: 450 or less.

#### 2.2 ACOUSTICAL TILES (24" x 24" tiles, where indicated in the drawings)

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

1. [Armstrong World Industries, Inc.](#)
2. [CertainTeed; SAINT-GOBAIN.](#)
3. [USG Corporation.](#)

- B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.
- C. Classification: basis of design: **Armstrong, Calla Health Zone Airassure, 24"x 24", Square Tegular Lay-in 15/16.**
- D. Color: White.
- E. Edge/Joint Detail: Square Tegular 15/16"
- F. Thickness: 1".
- G. Modular Size: 24"x 24".

### 2.3 ACOUSTICAL TILES (24" x 24" tiles, Concession)

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
1. [Armstrong World Industries, Inc.](#)
  2. [CertainTeed; SAINT-GOBAIN.](#)
  3. [USG Corporation.](#)
- B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.
- C. Classification: basis of design: **Armstrong, Clean Room VL, 24"x 24", Vinyl faced Square Lay-in 15/16.**
- D. Color: White.
- E. Edge/Joint Detail: Square.
- F. Thickness: 15/16".
- G. Modular Size: 24"x 24".

### 2.4 METAL SUSPENSION SYSTEM

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
1. [Armstrong Ceiling & Wall Solutions.](#)
  2. USG Corporation.
  3. CertainTeed

- B. Metal Suspension-System: Basis of Design:
  - 1. All interior, 24" x 24" tile locations: Armstrong Prelude XL exposed Tee Suspension System, Hot dipped galvanized 15/16" with G90 steel capping.
  - 2. Apparatus & Wash Bay: Armstrong Prelude Plus XL exposed Tee Suspension System, Hot dipped galvanized 15/16" with Aluminum Capping.
    - a. Provide Hold down clips for all tiles.

## 2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed; SAINT-GOBAIN.
  - 3. USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
  - 1. Do not use exposed fasteners, including pop rivets, on moldings and trim.

END OF SECTION 095123

## SECTION 09 67 23-RESINOUS (EPOXY) FLOORING

### POLY-CRETE SLB WITH EPOXY AND URETHANE TOPCOAT (Flintshot)

#### PART 1 – GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This section includes the following:

- 1. Resinous flooring system for the following spaces: as indicated in the finish schedule.

##### 1.3 SYSTEM DESCRIPTION: Basis of design: Dur-A-Flex, Poly-Crete SLB with Epoxy and Urethane Topcoat (Flintshot, amount to be selected by the architect from full range of slip resistant options)

- A. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system with Flintshot quartz aggregate (amount to be selected by the architect from mock-up samples made by contractor) broadcast with epoxy grout coat and urethane topcoat.
- B. The system shall have the color and texture as specified by the Owner with a nominal thickness of 3/16 inch. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

##### 1.4 SUBMITTALS

- A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Manufacturer's Safety Data Sheet (SDS) for each product being used.
- C. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

##### 1.5 QUALITY ASSURANCE

- A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
- B. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
- C. No requests for substitutions shall be considered that would change the generic type of the specified System.
- D. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
- F. A pre-installation conference shall be held between Applicator, General Contractor and the Owner for review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

##### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping
  - 1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.
- B. Storage and Protection

- 
1. The Applicator shall be provided with a dry storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
  2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal

1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.7 PROJECT CONDITIONS

A. Site Requirements

1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
3. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with cementitious urethane material.

1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured a minimum of 14 days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
3. Sealers and curing agents should not to be used.
4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements

1. The Owner shall be responsible for the removal of foodstuffs from the work area.
2. Non-related personnel in the work area shall be kept to a minimum.

1.8 WARRANTY

- A. The Contractor shall provide a 5 year warranty for product and installation against defects and / or deficiencies in accordance with the General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within the warranty period at no expense to the owner.

PART 2 – PRODUCTS

2.1 FLOORING

A. Dur-A-Flex, Inc, Poly-Crete SLB (self leveling broadcast quartz), seamless flooring system.

1. System Materials:
  - a. Topping: Dur-A-Flex, Inc, Poly-Crete SL resin, hardener and SL aggregate.
  - b. The aggregate shall be Dur-A-Flex, Inc. Flintshot quartz aggregate.
  - d. Grout coat: Dur-A-Flex, Inc. Dur-A-Glaze Shop Floor resin and hardener.
  - e. Topcoat: Dur-A-Flex, Inc. Armor Top resin and hardener and colorant
2. Patch Materials
  - a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Poly-Crete MD (up to ¼ inch).
  - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Dur-A-Tex UM.

2.2 MANUFACTURER

SECTION 09 67 23-RESINOUS (EPOXY) FLOORING

- A. Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802
- B. Manufacturer of Approved System shall be single source and made in the USA.

### 2.3 PRODUCT REQUIREMENTS

A. Topping	Poly-Crete SL
1. Percent Reactive	100 %
2. VOC	0 g/L
3. Bond Strength to Concrete ASTM D 4541	>400 psi, substrates fails
4. Compressive Strength, ASTM C 579	9,000 psi
5. Tensile Strength, ASTM D 638	2,175 psi
6. Flexural Strength, ASTM D 790	5,076 psi
7. Impact Resistance @ 125 mils, MIL D-3134, No visible damage or deterioration	160 inch lbs
B. Grout Coat	Dur-A-Glaze Shop Floor
1. VOC	8 g/L
2. Compressive Strength, ASTM D 695	17,500 psi
3. Tensile Strength, ASTM D 638	4,000 psi
4. Flexural Strength, ASTM D 790	6,250 psi
5. Flexural Modulus of Elasticity, ASTM D 790	6.2 x 10 <sup>5</sup>
6. Abrasion Resistance, ASTM D 4060 CS17 Wheel, 1,000 gm load, 1,000 cycles	24 mg loss
7. Flame Spread/NFPA-101, ASTM E 84	Class A
8. Flammability, ASTM D 635	Self Extinguishing
9. Indentation, MIL D-3134	0.025 Max
10. Impact Resistance MIL D-3134	Pass
11. Water Absorption. MIL D-24613	0.04%
C. Topcoat	Armor Top
1. Percent Solids	95 %
2. VOC	0 g/L
3. Tensile Strength, ASTM D 2370	7,000 psi
4. Adhesion, ASTM 4541	Substrate Failure
5. Hardness, ASTM D 3363	>4H
6. 60 <sup>0</sup> Gloss ASTM D 523	Satin: 50 +/-10 Gloss: 75 +/-10
7. Abrasion Resistance, ASTM D4060 CS 17 wheel (1,000 g load) 1,000 cycles	Gloss Satin
	4 8 mg loss with grit
	10 12 mg loss without grit
8. Pot Life, 70 F, 50% RH	120 Minutes
9. Full Chemical Resistance	7 days

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
  - 1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

### 3.2 PREPARATION

- A. General
  - 1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
  - 2. Moisture Testing: Perform tests recommended by manufacturer and as follows.

- a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
- b. If the relative humidity exceeds 99% then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.
3. Mechanical surface preparation
  - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
  - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
  - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 3/16 inch deep and 1/4 inch wide key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
  - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufacturer's recommendations.

### 3.3 APPLICATION

#### A. General

1. The system shall be applied in four distinct steps as listed below:
  - a. Substrate preparation
  - b. Topping/overlay application with quartz aggregate broadcast.
  - c. Grout coat application.
  - d. Topcoat application
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

#### B. Topping

1. The topping shall be applied as a self-leveling system as specified by the Architect. The topping shall be applied in one lift with a nominal thickness of 1/8 inch.
2. The topping shall be comprised of three components, a resin, hardener and filler as supplied by the Manufacturer.
3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
4. The topping shall be applied over horizontal surfaces using 1/2 inch "v" notched squeegee, trowels or other systems approved by the Manufacturer.
5. Immediately upon placing, the topping shall be degassed with a loop roller.
6. Quartz aggregate shall be broadcast to excess into the wet material at the rate of 1 lbs/sf. (final amount to be selected by the architect)
7. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

#### C. Grout Coat

1. The topcoat shall be squeegee applied and back rolled with a coverage rate of 80-90 sf/gal.

- 
2. The topcoat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of 1 part hardener to 2 parts resin and installed per the manufacturer's recommendations.

D. Topcoat

1. The topcoat shall be roller applied with dip and roll method at 3 mils.
2. The topcoat shall be comprised of a liquid resin, hardener and colorant mixed per the manufacturer's instructions.
3. The finish floor will have a nominal thickness of 3/16 inch.

3.4 FIELD QUALITY CONTROL

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
  - a. Temperature
    1. Air, substrate temperatures and, if applicable, dew point.
  - b. Coverage Rates
    1. Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.5 CLEANING AND PROTECTION

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

## SECTION 099113 – PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following Interior & Exterior substrates:
1. Concrete.
  2. Clay masonry.
  3. Steel.
  4. Galvanized metal.
  5. Aluminum (not anodized or otherwise coated).
  6. Wood.
  7. Gypsum board.
  8. Concrete Paving Markings (where applicable)
  9. Concrete Masonry Units

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

#### 1.3 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples 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 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of color selections will be based on benchmark samples.

- a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  1. Quantity: Furnish an additional 5 percent, but not less than 2 gallons of each material and color applied.

### PART 2 - PRODUCTS

#### 2.1 PAINT, GENERAL

- 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 the paint schedules.
- B. **Products:** Subject to compliance with requirements, provide one of the products in the paint schedules.
- C. **Manufacturers Names:** The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
  1. Devoe & Raynolds Co. (Devoe).
  2. Fuller-O'Brien Paints (Fuller).
  3. Glidden Co. (The) (Glidden).
  4. Benjamin Moore & Co. (Moore).
  5. PPG Industries, Inc. (PPG).
  6. Pratt & Lambert, Inc. (P & L).
  7. Sherwin-Williams Co. (S-W).

#### 2.2 PAINT MATERIALS, GENERAL

- A. **Material Compatibility:** Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. **Material Quality:** Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.
  2. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

## 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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Plaster: 12 percent.
  - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. 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.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 PAINTING SCHEDULE (Sherwin Williams products listed below are to indicate a level of quality coating only. Contractor may select an approved equal or better coating from any of the manufacturers listed within this specification)

A. Interior Painting Schedule

1. Wood (opaque)
  - a. Prime Coat: PrepRite Easy Sand Quick Dry Interior Alkyd Undercoater
  - b. Intermediate: ProMar 200 Interior Alkyd Semi-Gloss
  - c. Finish Coat: ProMar 200 Interior Alkyd Semi-Gloss
2. Wood (stained)
  - a. Prime Coat: Wood Classics Oil Stain
  - b. Intermediate: Polyurethane (finish to be selected by Architect)
  - c. Finish Coat: Polyurethane (finish to be selected by Architect)
3. Gypsum Board Walls
  - a. Prime Coat: PrepRite High Build Interior Latex Primer Surfacer
  - b. Intermediate: ProMar 200 Interior Latex Egg-Shell
  - c. Finish Coat: ProMar 200 Interior Latex Egg-Shell
4. Ferrous Metal (Spot prime factory primed items)
  - a. Prime Coat: Kem Kromik Universal Metal Primer
  - b. Intermediate: ProMar 200 Interior Alkyd Semi-Gloss
  - c. Finish Coat: ProMar 2—Interior Alkyd Semi-Gloss
5. Gypsum Board Ceilings
  - a. Prime Coat: PrepRite High Build Interior Latex Primer Surfacer
  - b. Intermediate: ProMar 200 Interior Latex Flat
  - c. Finish Coat: ProMar 200 Interior Latex Flat
6. Concrete Flooring Coating (Decorative Resinous Epoxy Flooring)
  - a. First Coat: Tnemec Series 222 Decotread 1/16”
  - b. Second Coat: Tnemec Series 222 Decotread 1/16”
  - c. Third Coat: Tnemec Series 284 Clear 14-16 mils (3 coats min.)
  - d. Fourth Coat: Tnemec Series 285 Satin Glaze 4-6 dry mils
7. Concrete Masonry Units
  - a. Prime Coat: LX02W0050- Loxon Concrete & Masonry Primer / Sealer
  - b. Intermediate: LX11W0051 – Loxon XP Masonry Coating
  - c. Finish Coat: LX11W0051 – Loxon XP Masonry Coating

B. Exterior Painting Schedule

1. Wood (Non Traffic Bearing)
  - a. Prime Coat: A-100 Exterior Oil Wood Primer
  - b. Intermediate: A-100 Exterior Latex Satin
  - c. Finish Coat: A-100 Exterior Latex Satin
2. Ferrous Metal (Spot prime factory primed items)
  - a. Prime Coat: Kem Kromik Universal Metal Primer
  - b. Intermediate: Industrial Enamel
  - c. Finish Coat: Industrial Enamel
3. Galvanized Metal
  - a. Prime Coat: Galvite HS Solvent Based Acrylic Coating
  - b. Intermediate: Industrial Enamel
  - c. Finish Coat: Industrial Enamel
4. Aluminum
  - a. Prime Coat: DTM Wash Primer
  - b. Intermediate: Industrial Enamel

- c. Finish Coat: Industrial Enamel
- 5. Cement Board (boards, panels, planks and trim)
  - a. Prime Coat: Loxon Exterior Acrylic Masonry Primer
  - b. Intermediate: A-100 Exterior Latex Satin
  - c. Finish Coat: A-100 Exterior Latex Satin
- 6. Concrete (Transparent)
  - a. Intermediate: H&C HB100 Siloxane Water Repellent
  - b. Finish Coat: H&C HB100 Siloxane Water Repellent
- 7. Brick
  - a. Prime Coat: LX02W0050-LXN C&M Primer WH
  - b. Intermediate: A89W01151- SuperPaint Exterior Latex Satin Extra White
  - c. Finish Coat: A89W01151- SuperPaint Exterior Latex Satin Extra White
- 8. Concrete Pavement Markings (traffic bearing)
  - a. Intermediate: SetFast Acrylic Waterborne Traffic Marking Paint
  - b. Finish Coat: SetFast Acrylic Waterborne Traffic Marking Paint
- 9. Concrete Masonry Units
  - a. Prime Coat: LX02W0050- Loxon Concrete & Masonry Primer / Sealer
  - b. Intermediate: LX11W0051 – Loxon XP Masonry Coating
  - c. Finish Coat: LX11W0051 – Loxon XP Masonry Coating

END OF SECTION 099113

## SECTION 101416 - PLAQUES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal plaques.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.

C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

#### 1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 METAL PLAQUES

- A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ACE Sign Systems, Inc.
    - b. Gemini Signage; Gemini, Inc.
    - c. Metallic Arts.
    - d. Signs & Decal Corp.
  2. Plaque Material: Cast bronze.
  3. Plaque Thickness: **0.50 inch** (12.7 mm).
  4. Finishes:
    - a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
    - b. Overcoat: Manufacturer's standard baked-on clear coating.
  5. Background Texture: As selected by Architect from manufacturer's full range.
  6. Integrally Cast Border Style: As indicated on Drawings.
  7. Mounting: Concealed studs.

### 2.2 MATERIALS

- A. Brass Castings: ASTM B584, lead-free alloy recommended by manufacturer and finisher for finish indicated.

### 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. Plaque Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.

### 2.4 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
  5. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF METAL PLAQUES

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
  2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
  4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
- C. Remove temporary protective coverings and strippable films as plaques are installed.

END OF SECTION 101416

## SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Solid-plastic toilet compartments.

##### B. Related Requirements:

1. Section 061000 "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments and overhead support of post-to-ceiling screens.
2. Section 092216 "Non-Structural Metal Framing" for blocking.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

#### 1.2 ACTION SUBMITTALS

##### A. Product data.

##### B. Shop Drawings: Plans, elevations, sections, details, and attachment details.

##### C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

#### 1.3 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

##### A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

##### B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least **250 lbf (1112 N)** applied at any direction and at any point, without deformation of panel.

##### C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" for toilet compartments designated as accessible.

## 2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASI Accurate Partitions.
  2. All American Metal Corp.
  3. American Sanitary Partition Corporation.
  4. General Partitions Mfg. Corp.
  5. Hadrian Inc.; Zurn Industries, LLC.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Entrance-Screen Style: Overhead braced.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than **1 inch (25 mm)** thick, seamless, with eased edges, and with homogenous color throughout thickness of material. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  2. Color: in each room as selected by Architect from manufacturer's full range.
- F. Entrance-Screen Construction: Matching panel construction.
- G. Urinal-Screen Construction: Matching panel construction.
- H. Pilaster Shoes: Manufacturer's standard design; solid plastic or stainless steel.
1. Plastic Color: Contrasting with pilaster, as selected by Architect from manufacturer's full range.
- I. Pilaster Sleeves (Caps): Manufacturer's standard design; solid plastic or stainless steel.
1. Plastic Color: Contrasting with pilaster, as selected by Architect from manufacturer's full range.
- J. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, aluminum.
  2. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

## 2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. Mount with through bolts.
1. Hinges:

- a. Manufacturer's continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
  - 1) Material, Continuous Hinge: Aluminum.
- 2. Latch and Keeper: Manufacturer's surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
  - a. Material: Aluminum.
- 3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
  - a. Material: Manufacturer's standard.
- 4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.
  - a. Material: Stainless steel.
- 5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
  - a. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: **ASTM B221** (ASTM B221M).
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

## 2.5 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels or Screens: 1/2 inch (13 mm).
    - b. Panels or Screens and Walls: 1 inch (25 mm).
    - c. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
    - d. Align brackets at pilasters with brackets at walls.
  - 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102113.19

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Underlavatory guards.
  - 3. Custodial accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product data.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
1. Grab Bars: Installed units are able to resist **250 lbf (1112 N)** concentrated load applied in any direction and at any point.

## 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bradley
  2. Bobrick.
  3. American Specialties, Inc..
- B. Toilet Paper Dispensers: 9” jumbo Roll toilet Tissue Dispenser, Surface Mounted
1. Description: Double-roll dispenser.
  2. Mounting: Surface mounted.
  3. Capacity: Designed for 9” diameter jumbo tissue rolls.
  4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Warm-Air Hand Dryer:
1. Description: Standard-speed, warm-air hand dryer.
  2. Mounting: Surface mounted.
    - a. Protrusion Limit: Installed unit protrudes maximum **4 inches (102 mm)** from wall surface.
  3. Operation: Infrared-sensor activated with timed power cut-off switch.
    - a. Automatic Shutoff: At 40 seconds.
  4. Maximum Sound Level: 67 dB.
  5. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  6. Electrical Requirements: Contractor shall coordinate with building electrical design.
- D. Soap Dispenser:
1. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
  2. Mounting: Vertically oriented, surface mounted.
  3. Capacity: to match park facility contracted product.
  4. Materials:.
  5. Lockset: Tumbler type.
  6. Refill Indicator: Window type.
- E. Grab Bar as indicated in the drawings:
1. Mounting: Flanges with concealed tamper resistant fasteners.
  2. Material: Stainless steel, **0.05 inch (1.3 mm)** thick.
    - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. OD: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings.

F. Mirror Unit: 18" x 30" Bradley 748-018300 mirror or approved equal.

1. Size: As indicated on Drawings.
2. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

## 2.3 CHILDCARE ACCESSORIES

A. Diaper-Changing Station: Provide one changing station per restroom:

1. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
  - a. Engineered to support minimum of 250 lb (113 kg) static load when opened.
2. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: HDPE in manufacturer's standard color.
5. Liner Dispenser: Provide separate, locking dispenser for disposable sanitary liners.

## 2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard : Basis of Design: Trubro molded plastic, insulated.

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

## 2.5 CUSTODIAL ACCESSORIES

A. Custodial Mop and Broom Holder: Provide two total (Janitors Closet & Storage Room)

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches (914 mm).
3. Hooks: Four.
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
  - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

## 2.6 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

END OF SECTION 102800

## SECTION 104413 - FIRE EXTINGUISHER CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 2 (patterned, textured).

#### 2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. J. L. Industries, Inc., a division of Activar Construction Products Group.
  - b. Larsen's Manufacturing Company.
- B. Cabinet Construction: Nonrated
- C. Cabinet Material: Steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
- 1. Rolled-Edge Trim: **2-1/2-inch (64-mm)** backbend depth.
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Door Style: Fully glazed, frameless, backless, acrylic panel.
- H. Door Glazing: Acrylic sheet.
- 1. Acrylic Sheet Color: Clear transparent acrylic sheet painted black on unexposed side.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 2. Door Lock: friction latch that allows door to be opened during emergency by pulling sharply on door handle.
  - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
    - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER".
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Pressure-sensitive vinyl letters.
      - 3) Lettering Color: White.
      - 4) Orientation: Vertical.
- K. Finishes:
- 1. Manufacturer's standard baked-enamel paint for the following:
    - a. Exterior of cabinet door and trim, except for those surfaces indicated to receive another finish.
    - b. Interior of cabinet.

## 2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply vinyl lettering at locations indicated.
- E. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- F. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

#### 1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

#### 1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
  - 1. 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:
    - a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - b. Larsen's Manufacturing Company.
  - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type >: UL-rated 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

### 2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
  - 1. 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:
    - a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
    - b. Larsen's Manufacturing Company.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: **54 inches (1372 mm)** above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

## SECTION 116600 – ATHLETIC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. This section includes all court systems including:
  - a. Pickleball Court preparation, surfacing and coating systems
  - b. Pickleball Court netting systems
  - c. Pickleball Court fencing systems

- B. Work and products to be included:

- 1. The Contractor shall provide all furnishings, components, surfacing, including consultants, preparation, installation, labor, etc, provide a complete USA Pickleball professional regulation approved court system. This shall include court coatings, striping, netting, and accessories required.

- C. Codes and Standards:

- 1. All work required for sub-base, post-tension slab, drainage, fencing, etc shall be outlined in the American Sports Builders Association (ASBA)

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For athletic equipment.

- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include details of field assembly for all equipment, netting, posts, tension equipment, connections, installation, mountings, slab inserts, attachments to other work, and operational clearances. Shop drawings shall also include all court layouts, striping, including, but not limited to USA Pickleball regulation clearances for runout to fence lines / posts as required to conform to regulation courts.
- 3. Provide a list of all materials, equipment and accessories including manufacturer. All components shall be provided as a complete system and shall be compatible and conform to ASBA standards.

- C. Samples: For each exposed product and for each item and color specified.

- D. Samples for Initial Selection: For each type of athletic equipment.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Court layout plans, drawn to scale, and coordinated with court nets and accessories, posts, inserts, game lines, and markers applied to finished flooring. Contractor will be responsible for ensuring all layouts conform to USA Pickleball regulations for professional play.
- B. Qualification Data For Installer:
  - 1. The Contractor, or subcontractor building the court system (including the post tension court system) shall be in good standing with the American Sports Builders Association (ASBA) and hold a minimum of five (5) years of experience constructing post-tension sports court systems. The Contractor shall provide to the Architect, written documentation of the ASBA standing, documentation of similar projects successfully completed within the past 5 year period.
  - 2. The installer shall be manufacturer certified and experienced installing all equipment, coatings and systems.
- C. Product Certificates: For each type of equipment.
- D. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For equipment to include operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Minimum of five (5) years experience with similar projects with a list of at least five (5) similar jobs completed within the last five (5) years.
  - 2. Contractor, or installer must be a member in good standing with the American Sports Builders Association. (ASBA) This is to ensure that the contractor has met the requirements set forth to be able to perform this specialty work.
  - 3. Contractor, or installer must be licensed in the state in which the work is to be performed and entitled to practice the following classifications: Tennis courts, sports courts and Athletic tracks.
  - 4. The synthetic surfacing material manufacturer shall submit a letter stating that the surfacing contractor is qualified to install it's synthetic surface products and systems.
  - 5. The Contractor, or installer building the court system (including the post tension court system) shall be in good standing with the American Sports Builders Association (ASBA) and hold a minimum of five (5) years of experience constructing post-tension sports court systems. The Contractor shall provide to the Architect, written documentation of the ASBA standing, documentation of similar projects successfully completed within the past 5 year period.
  - 6. The installer shall be manufacturer certified and experienced installing all equipment, coatings and systems.

## 1.7 COORDINATION

- A. Coordinate installation of slab inserts, fence post locations (including chain link position relative to centerline of post), netting posts, anchors, and court striping.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer and Contractor agree to repair or replace components of court equipment, court surfacing, and netting (including components) that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 1 year from date of Substantial Completion.

## 1.9 PRODUCTS

### A. MATERIALS FOR COLOR COATING SYSTEM

#### 1. Court surfacing and coating systems:

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

- 1) World Class Athletic Surfaces
- 2) Laykold- by (APT) Advanced Polymer Technologies
- 3) Deco Turf- by California Products Corp.
- 4) Plexipave- by California Products Corp.
- 5) Acrytec- by AT Sports
- 6) Arizona Courtlines, Inc.

### B. Approved Materials:

- 1. Epoxy Primer
- 2. Concrete Primer
- 3. Patch Binder (Latex cement additive)
- 4. Acrylic Crack Filler
- 5. Acrylic Resurfacer
- 6. Color Concentrate (paint)
- 7. Textured Line Paint
- 8. Silica Sand (80-120 mesh)
- 9. Water (clean and fresh)

- C. All colors shall be selected by the Architect from the Manufacturer's full range of available colors.

- 1. The contractor shall provide for a minimum of four (4) total colors in the base bid, allowing for a different color for the Lines, Service Area, Non-Volley Zone, and perimeter (out of bounds) area.

## 1.10 SURFACING PROCEDURES

### A. Surface Preparation

- 1. The surface to be coated must be sound, have adequate drainage, and must be washed to remove any dirt, grease, dust, and or any delaminated areas. All patching must be completed before surfacing materials are applied. All concrete must be cured for a period of 30 days prior to surfacing. Surface drainage must be. minimum of 0.56% (1" per 15' slope) up to a maximum of 0.83% (1" per 10').

### B. Acid Etching

1. NEW Concrete slabs must be etched with Phosphoric or Muriatic Acid. Acid must be mixed properly and applied with a broom to ensure proper etching. Acid shall remain on slab until all etching is complete. Acid shall be completely pressure washed off immediately after etching.
- C. Flooding and Patching
1. Slab must be flooded to expose birdbaths (areas that hold water). Flood slab, then allow slab to drain for 1 hour in warm sunny conditions, more time must be allowed during colder overcast conditions. After proper draining, mark all birdbaths that are greater than 1/8" (nickel depth). All birdbaths must be patched using approved Court Patch Binder Mix. All areas that need patching shall be primed first. Adequate parts of patch binder, silica sand, and Portland cement shall be blended together and applied for a resilient patch. All patches shall blend into existing slab. Some sanding may be required for blending. Fill all cracks with approved tennis court crack filler. Bad cracks may need to be coated with Acrylic Re-surfacer before surfacing materials are applied.
- D. Prime Coat (on new slabs) – as per manufactures recommendations
1. All Resurfacing on top of existing acrylic surfacing must be primed by mixing 1part acrylic Concrete Primer to 2 parts water. Primer must be applied with a broom to ensure proper priming. Primer should not be allowed to puddle.
  2. All new concrete slabs – 1L cement - must include an epoxy primer. All non-typical slabs that do not have a moisture barrier, or that do not have a broom texture finish, or that have flyash in the concrete mix design, must use an epoxy primer. epoxy primer must be applied with a roller, or spray applied using an airless sprayer.
- E. Acrylic Resurfacer - Base Coat (one coat new concrete courts, or existing courts. Two coats required for extremely rough courts). Apply one coat of Acrylic Resurfacer – as per manufactures recommendations, to improve the look and planarity of the slab, provide a tight blemish free base, and to provide better adhesion for the paint surface. Adequate parts of sand, water, and Acrylic Resurfacer shall be blended together to provide a resilient base. Acrylic Resurfacer shall be applied by method of squeegee at a rate of .04 - .06 gallons per sq./yd. for the purpose of filling in small pits and covering small voids. (Slab shall be scraped between all coats to remove trash that may collect while applying) important: (2) coats of acrylic resurfacer are required on any court that has a rough texture.
- F. Paint Surfacing
1. Apply two coats of Color Concentrate (Court Paint). Adequate parts of sand, water, and Color Concentrate shall be blended together to provide a resilient surface. Paint shall be applied by method of squeegee at a rate of .04 - .05 gallons per sq/yd for the purpose of filling in small pits and covering small voids. Allow enough time for paint coats to thoroughly dry before re-coating. (Slab may need to be scraped before applying second coat of paint)

G. Line Striping

1. Apply two coats of textured line paint after final surfacing coat is thoroughly dried. Lines must be 2" in width and shall conform to the regulations set forth by the American Sports Builders Association (USTC & TBA).

1.11 Execution:

1. Pre-installation meeting
  - a. To be schedule and coordinated by the Contractor with the Architect to outline the scope of work and time line.
2. Concrete shall cure for a minimum of 28 days and shall not contain curing agents.

1.12 INSTALLATION OF COURT FENCING AND RELATED WORK

- A. Perimeter fence and gates shall be done in accordance to Section 323113 unless otherwise noted.
- B. Perimeter fencing shall be 9 gauge vinyl coated black 8' chain link with wind screen netting installed at locations indicated in the drawings.
- C. Wind screen netting: Basis of Design: Douglas Viny Coated Polyester Windscreen or approved equal.
  1. Fabric: 50% Vinyl, 50% Polyester
  2. 9 x 12 Weave
  3. Windbreak 80%
  4. 8 oz. per square yard
  5. Tensile Strength: 230 x 200
  6. Available Colors: Dark Green, Black, Royal Blue, Red and Open Tournament Blue, to be chosen by the Architect
  7. Reinforced 3-Ply Hems with #2 Brass Grommets Spaced Every 18" Top, Bottom (and center if applicable) and Every 12" on Sides.
  8. Provide Reinforced Air Vents Every 10' On Center (verify with Architect prior to ordering)
  9. UV and Weather Treated
  10. Provide all S-hooks, ties, braided rope and accessories required for a complete installation.
- D. Interior court divider fencing, 3'-6" high, as indicated in the drawings.
  1. Interior court fencing shall be 9 gauge vinyl coated black 3'-6" tall chain link installed at locations indicated in the drawings.

1.13 COURT NETTING AND ASSOCIATED WORK

- A. Pickleball Net Basis of Design: Douglas JTN-30 QuickStart/Pickleball Tennis Net #20105 or approved equal.
  1. Contractor shall provide all accessories, components, and installation required for a complete net installation conforming to American Sports Builders Association (ASBA) and USA Pickleball association requirements.
  2. Netting and components shall be fabricated in the USA.
  3. Provide the followings Douglas accessories (Basis of design or approved equal)

- a. Center strap, Deluxe #20600, 2" wide, two non-slip reverse web slides with swivel loop bolt snap
- b. Center Pipe Anchor # 63428, 1.9" OD galvanized steel (recessed into slab)
- c. Premier RD #63071 or # 63070 (black or green to be selected by the Architect), 3" round post.
  - 1) Heavy duty 11ga steel
  - 2) Internally wound featuring self-locking gear mechanism
  - 3) Polyester Powder coated finish.
  - 4) Integrated welded steel lacing rods
  - 5) Flush mounted gear plate cover and removeable handle (chrome plated)
  - 6) Provide corresponding ground sleeves recessed into slab. (provide plugs for when netting is removed or not in use)

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, and other conditions affecting performance of the Work.
  - 1. Verify critical dimensions.
  - 2. Examine supporting structure, subgrades, and footings of associated PEMB.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 2.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicate.
- B. Permanently Placed Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
  - 1. Floor Insert Location: Coordinate location with application of game lines and markers, as recommended by ASBA standards
- C. Floor Insert Setting: as recommended by ASBA standards

### 2.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

2.4 CLEANING

- A. After completing equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

2.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 116623

## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Manually operated roller shades with Dual rollers.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

##### C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Product certificates.

##### B. Product test reports.

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

##### A. Installer Qualifications: Fabricator of products.

### PART 2 - PRODUCTS

#### 2.1 MANUALLY OPERATED SHADES WITH DUAL ROLLERS

##### A. Basis of design: Draper, FlexShade XD, clutch, Dual Roller, with clear anodized Hardware finish.

##### B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

- C. Rollers: extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
- D. Installation Accessories:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - 3. Endcap Covers: To cover exposed endcaps.
  - 4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.2 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer.
  - 2. Openness Factor: to be selected by the Architect from the Manufacturer's full line.
  - 3. Color: As selected by Architect from manufacturer's full range.
- C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer.
  - 2. Color: As selected by Architect from manufacturer's full range.

## 2.3 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
  - 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

## PART 3 - EXECUTION

### 3.1 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

## SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Quartz agglomerate countertops.
  2. Quartz agglomerate backsplashes.
  3. Quartz agglomerate end splashes.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

### PART 2 - PRODUCTS

#### 2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. LG Chemical, Ltd.
    - b. Meganite Inc.
    - c. Technistone USA, Inc.
    - d. Wilsonart LLC.
  2. Colors and Patterns: As selected by Architect from manufacturer's full range.

#### 2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Grade: Custom.

- B. Countertops: [3/4-inch- (19-mm-)] thick, quartz agglomerate with front edge built up with same material.
- C. Backsplashes: 3/4-inch- (19-mm-) thick, quartz agglomerate.
- D. Joints: Fabricate countertops without joints.
- E. Joints: Fabricate countertops in sections for joining in field.
- F. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures[ **in shop**] using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

### 2.3 INSTALLATION MATERIALS

- A. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- F. Install aprons to backing and countertops with adhesive.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

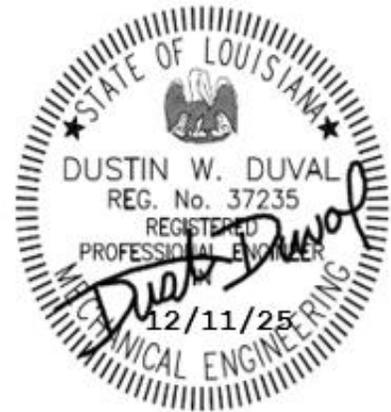
END OF SECTION 123661.19

## SECTION 22 00 00 – PLUMBING GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The General Conditions of the Architectural Specifications, along with the supplementary conditions, special conditions, information to bidders, and any other pertinent information and documents shall apply the same as if repeated herein.



#### 1.2 SCOPE OF WORK

- A. Furnish all labor and material necessary to provide and install the complete mechanical portion of this Contract, including plumbing systems as called for herein and on accompanying drawings. Parts of the mechanical division may be bid separately or in combination, at the Contractor's option; however, it shall be the responsibility of the General Contractor to assure himself that all items covered in this Division have been included if he chooses to accept separate bids.
- B. This Contractor shall refer to the Architectural and Structural drawings and install equipment, piping, etc. to meet building and space requirements. No equipment shall be bid on or submitted for approval if it will not fit in the space provided.
- C. It is the intention of these Specifications that all mechanical systems shall be furnished complete with all necessary valves, controls, insulation, piping, devices, equipment, etc. necessary to provide a satisfactory installation in working order.
- D. Contractor shall visit the site and acquaint himself thoroughly with all existing facilities and conditions that would affect his portion of the work. Failure to do so shall not relieve the Contractor from the responsibility of installing his work to meet the conditions.
- E. This Contractor shall protect the entire system and all parts thereof from injury throughout the project and up to acceptance of the work. Failure to do so shall be sufficient cause for the Architect to reject any piece of equipment.

#### 1.3 DEMOLITION

- A. The contractor shall visit the site prior to bid to determine the extent of work required to complete the project.
- B. Contractor shall coordinate demolition with owner. The Owner shall have "First Right of Refusal" regarding salvage of all equipment and materials to be removed. Locate equipment as directed by owner. All equipment and materials not salvaged by the owner shall be removed from the site and discarded at the contractor's expense.

- C. Contractor shall coordinate all work with general contractor and phase work as required by project.
- D. All equipment piping, etc. required to be removed to accommodate the modifications shall be removed.
- E. Contractor shall maintain services to existing facilities which shall remain during and after construction is complete.
- F. Contractor shall coordinate any shutdown of services with the owner. It is intended that the building will remain occupied during construction. Contractor shall schedule shut down of services with the owner in order to prevent disruption of building occupancy.
- G. Contractor shall be responsible for draining down of existing systems to complete demolition. All work shall be scheduled with the owner. Contractor shall also be responsible for refilling system and removing all air in order to return the systems to proper operating conditions.
- H. All shut down of services shall be done at night or during a time period approved by the owner. The systems shall be required to be back up and running each morning unless otherwise approved by the owner.

#### 1.4 GROUNDS AND CHASES

- A. This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of his work are properly built in as the work progresses; otherwise, he shall bear the cost of providing them.

#### 1.5 CUTTING AND PATCHING

- A. Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor being responsible for laying out and marking any and all holes required for the reception of his work. No structural beams or joists shall be cut or thimble without first receiving the approval of the Architect. After initial surfacing has been done, any further cutting, patching and painting shall be done at this Contractor's expense.

#### 1.6 FILL AND CHARGES FOR EQUIPMENT

- A. Fill and charge with materials or chemicals all those devices or equipment as required to comply with the manufacturer's guarantee or as required for proper operation of the equipment.

#### 1.7 MACHINERY GUARDS

- A. This Contractor shall provide v-belt guards for each v-belt drive or other hazardous drive. The guard shall enclose the drive entirely and shall have a hole for taking a tachometer reading.
- B. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys and other rotating parts which are located such that a person might come in close proximity. Construct protective guard around angle iron frame, securely bolted to apparatus; comply with

safety requirements. Install guard to completely enclose drives and pulleys and not interfere with lubrication of equipment. Provide 2 inch minimum diameter opening in fan belt guards housing for tachometer.

#### 1.8 REPAIRING ROADWAYS AND WALKS

- A. Where this Contractor cuts or breaks roadways or walks, in order to lay piping, he shall repair or replace these sections to meet the Architect's approval.

#### 1.9 EXCAVATION AND BACKFILL

- A. Contractor shall perform all excavating necessary to lay the specified services. Perform excavation of every description and of whatever substance encountered to depths indicated or specified. Pile materials suitable for backfilling a sufficient distance from banks of trenches to prevent slides or cave-ins. Comply with OSHA requirements for excavation, trenching and shoring. Waste excavation materials, rubbish, etc. shall be carted away from the premises, as indicated. Remove water from trenches by pumping or other approved method, discharge at a safe distance from the excavation.
- B. Provide trenches of necessary width for proper laying of pipe and comply with latest publication of OSHA 2226 Excavating and Trenching Operations. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods. Accurately grade bottoms of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil or the required thickness of bedding material at every point along its entire length.
- C. Provide minimum 12 inches between outer surfaces and embankment or shoring, which may be used, when excavating for manholes and similar structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.
- D. Material to be excavated is "unclassified". No adjustment in the contract price will be made on account of the presence or absence of rock, shale, masonry, or other materials.
- E. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines encountered during excavating and trenching operations, from damage during excavating, trenching and backfilling; if damaged, repair lines as directed by utilities, owner and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.
- F. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grades, or depths of cover in accordance with the manufacturer's recommendations, whichever is lower:
  - 1. 1-Foot Minimum Cover: Sanitary sewer, storm drainage, industrial waste, acid waste.
  - 2. 3-Feet Minimum Cover: Domestic water, fire line.

- G. Underground domestic water piping and fire line piping shall have a 6" bed of sand below the piping and backfilled with sand to 6" above the top of piping. Select fill may be used above the sand layer.
- H. Backfill trenches after piping, fittings and joints have been tested and approved. Backfill trenches with sand to provide 6 inches of sand below piping and 12 inches of sand cover above piping.
- I. Backfill remainder of trenches with satisfactory material consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones not over 1-1/2 inches in size. Deposit backfill material in 9 inch maximum layers, loose depth as indicated or as specified. Take care not to damage utility lines.
- J. Deposit the remainder of backfill materials in the trench in 1 foot maximum layers and compact by mechanical means. Refer to architectural for minimum density for compaction (Minimum 85 percent of maximum soil density as determined by ASTM D 698). Re-open trenches and excavation pits improperly backfilled or where settlement occurs to the depth required to obtain the specified compaction, the refill and compact with the surface restored to the required grade and compaction.
- K. Backfill utility line trench with backfill material, in 6 inch layers, where trenches cross streets, driveways, building slabs, or other pavement. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

#### 1.10 NOISE AND VIBRATION

- A. Provide the plumbing system and its associated components, items, piping, and equipment free of objectionable vibration or noise. Statically and dynamically balance rotating equipment and mount or fasten so that no vibration is transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional compensation.

#### 1.11 PAINTING

- A. All painting shall be by the General Contractor's Painting Sub-Contractor. All pipe, pipe covering, equipment, supports, hangers, etc. exposed in the building or equipment room shall be painted. This Contractor shall prepare the surface of the material to receive the first coat of paint.
- B. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded.

- C. All piping shall be color coded per the following:
- |   |        |
|---|--------|
| 1. Natural Gas Piping (Exposed in Mechanical Room)          | Yellow |
| 2. Natural Gas Piping (Outdoor, Roof, Exterior of Building) | Yellow |
| 3. Natural Gas Piping (Exposed in Building)                 | Black  |
| 4. Storm Drain Piping (Exposed in Building)                 | Black  |
| 5. Sanitary Sewer Waste & Vent (Exposed in Building)        | Black  |
- a. Thermoplastic pipe and fittings shall be painted using latex(water base) paint .
  - b. Pipe should be cleaning to remove moisture, dirt and oil; then wiped with a clean, dry cloth.
  - c. Do not use petroleum based paints.

#### 1.12 CLEANING AND ADJUSTING

- A. Upon completion of his work, the Contractor shall clean and adjust all equipment, controls, valves, etc.; clean all piping, ductwork, etc.; and leave the entire installation in good working order.

#### 1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide the Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts lists, maintenance and repair instructions and test and balance report.
- B. COPIES OF SHOP DRAWINGS WILL NOT BE ACCEPTABLE AS OPERATION AND MAINTENANCE INSTRUCTIONS BUT MUST BE INCLUDED IN SUBMITTAL PACKAGE.
- C. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of equipment. Submit manuals to the Architect for approval.
- D. In addition to the operation and maintenance brochure, the Contractor shall provide a separate brochure which shall include registered warranty certificates on all equipment, especially any pieces of equipment which carry warranties exceeding one (1) year.
- E. The operation and maintenance brochure shall be furnished with a detailed list of all equipment furnished to the project, including the serial number and all pertinent nameplate data such as voltage, amperage draw, recommended fuse size, rpm, etc. The Contractor shall include this data on each piece of equipment furnished under this contract.

#### 1.14 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the project. This guarantee shall include furnishing of all labor and material necessary to make any repairs, adjustments or replacement of any equipment, parts, etc. necessary to restore the project to first class condition. This guarantee shall exclude only the changing or cleaning of filters. Warranties exceeding one (1) year are hereinafter specified with individual pieces of equipment.

#### 1.15 LOCAL CONDITIONS

- A. The location and elevation of all utility services is based on available surveys and utility maps and are reasonably accurate; however, these shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his satisfaction in order to determine the amount of work required for the execution of the Contract.
- B. The Contractor shall contact the various utility companies, determine the extent of their requirements and he shall include in his bid all lawful fees and payments required by these companies for complete connection and services to the building, including meters, connection charges, street patching, extensions from meters to main, etc.
- C. In case major changes are required, this fact, together with the reasons therefor, shall be submitted to the Architect, in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions and expenses necessary for the successful completion of the project.

#### 1.16 PERMITS, INSPECTIONS AND TESTS

- A. All permits, fees, etc. for the installation, inspections, plan review, service connections locations, and/or construction of the work which are required by any authority and/or agencies having jurisdiction, shall be obtained and paid for by the Contractor. This shall be verified during the bidding process.
- B. The Contractor shall make all tests required by the Architect, Engineer or other governing authorities at no additional cost to the Owner.
- C. The Contractor shall notify the Architect and local governing authorities before any tests are made, and the tests are not to be drawn off a line covered or insulated until examined and approved by the authorities. In event defects are found, these shall be corrected and the work shall be retested.
- D. Prior to requesting final inspection by the Architect, the Contractor shall have a complete coordination and adjustment meeting of all of his sub-contractors directly responsible for the operation of any portion of the system. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Architect in writing ten (10) days prior to this meeting, instructing him of the time, date and whom you are requesting to be present.
- E. This project shall not be accepted until the above provisions are met to the satisfaction of the Architect.

#### 1.17 CODES AND STANDARDS

- A. The entire mechanical work shall comply with the rules and regulations of the City, Parish, County and the State in which this project is being constructed, including the State Fire Marshal and the State Department of Health. Modifications required by these authorities shall be made without additional charge to the Owners. The Contractor shall report these modifications to the Architect and secure his approval before work is started.

- B. In addition to the codes heretofore mentioned, mechanical work and equipment shall conform to the applicable portions of the following specifications, codes and/or regulations:
1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  2. National Electrical Code (NEC)
  3. National Fire Protection Association (NFPA)
  4. American Society of Mechanical Engineers (ASME)
  5. American Gas Association (AGA)
  6. International Building Code (IBC)
  7. International Mechanical Code (IMC)
  8. International Plumbing Code (IPC)
  9. International Fuel Gas Code (IFGC)
  10. Underwriters Laboratories (UL)
  11. Life Safety Code (NFPA 101)
  12. State Sanitary Code
  13. Louisiana State Uniform Construction Code Council (LSUCCC)
  14. Facility Guidelines Institute "Guidelines for Design and Construction of Hospitals and Outpatient Facilities" (2014 Edition)
- C. All materials, equipment and accessories installed under this Contract shall conform to all rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment and accessories. All materials shall be new and of the best quality and first class in every respect. Whenever directed by the Architect, the Contractor shall submit a sample for approval before proceeding.
- D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such equipment be furnished complete with the necessary accessories, whether or not called for in these Specifications.
- E. All unfired pressure vessels shall be built in accordance with the A.S.M.E. Code and so stamped. Furnish shop certificates for each vessel.

#### 1.18 REVIEW OF MATERIALS

- A. Whenever manufacturers or trade names are mentioned in these Plans or Specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only, and should not be construed to infer a preference. Equivalent products which meet the Architect's approval will be accepted; however, these products must be submitted to the Architect a minimum of seven (7) days prior to the Bid Date.
- B. Submission shall include the manufacturer's name, model number, rating table and construction features.
- C. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. **THE CONTRACTOR SHALL BASE HIS BID SOLELY ON THOSE ITEMS SPECIFIED OR INCLUDED IN THE "PRIOR APPROVAL ADDENDUM", AS NO OTHER ITEM WILL BE ACCEPTABLE.**

- D. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with the Plans and Specifications and that it will fit into the space provided. Shop drawings must be submitted on all items of equipment for approval as hereinafter specified.
- E. Before proceeding with work and/or within thirty (30) days after the award of the General Contract for this work, the Mechanical Contractor shall furnish to the Architect complete shop and working drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this project. These drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.
- F. The Architect's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other errors which may be contained in these drawings. Any omission from the shop drawings or specifications, even though approved by the Architect, shall not relieve the Contractor from furnishing and erecting same.
- G. Six (6) sets of shop drawings shall be submitted to the Architect for approval. These submittals shall be supplied as part of this Contractor's contract. Any drawings not approved shall be resubmitted until they are approved.
- H. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of materials and equipment. Submit shop drawings to the Architect for approval. Faxed copies submissions will not be accepted.

#### 1.19 MINOR DEVIATIONS

- A. Plans and detail sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes and manner of erecting work. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required. However, specified sizes and requirements necessary for satisfactory operation shall remain unchanged. It may be necessary to shift ducts or pipes, or to change the shape of ducts, and these changes shall be made as required. All such changes shall be referred to the Architect and Engineer for approval before proceeding. Extra charges shall not be allowed for these changes. The contractor shall obtain a full set of plans and specifications for the coordination of his work prior to bidding this project. Items which are unclear to the bidding contractor shall be brought to the Architect and Engineers attention prior to bidding the project. An interpretation shall be clarified by the Architect and/or the Engineer prior to bidding.
- B. The Contractor shall realize that the drawings could delve into every step, sequence or operation necessary for the completion of the project, without drawing on the Contractor's experience or ingenuity. However, only typical details are shown on the Plans. In cases where the Contractor is not certain about the method of installation of his work, he shall ask for details. Lack of details will not be an excuse for improper installation.
- C. In general, the drawings are diagrammatic and the Contractor shall install his work in a manner so that interferences between the various trades are avoided. In cases where interferences do occur, the Architect is to state which item was first installed.

## 1.20 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall obtain at his cost, two sets of blue line prints of the original bid documents by the Architect. One set shall be kept on the site with all information as referenced below, and shall update same as the work progresses. The other set will be utilized to record all field changes to a permanent record copy for the Owner.
- B. If the Contractor elects to vary from the Contract Documents and secures prior approval from the Architect for any phase of the work, he shall record in a neat and readable manner, ALL such variances on the blackline print in red. The original blackline prints shall be returned to the Architect for documentation.
- C. All deviations from sizes, locations, and from all other features of the installations shown in the Contract Documents shall be recorded.
- D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions and the like, as well as other features of the work which will be concealed underground and/or in the finished building.
- E. Locations of underground work shall be established by dimensions to columns, lines or walls, locating all turns, etc., and by properly referenced centerline or invert elevations and rates of fall.
- F. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. The Architect's/Engineer's decision in this matter will be final.
- G. The following requirements apply to all "As-Built" drawings:
  - 1. They shall be maintained at the Contractor's expense.
  - 2. All such drawings shall be done carefully and neatly, and in a form approved by the Architect/Engineer.
  - 3. Additional drawings shall be provided as necessary for clarifications.
  - 4. These drawings shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by the Architect/Engineer; and when necessary, to establish clearances for other parts of the work.
  - 5. "As-built" drawings shall be returned to the Architect upon completion of the work and are subject to approval of the Architect/Engineer.

## 1.21 REQUIRED SHOP DRAWING SUBMITTALS

- A. Provide the following shop drawing submittals:
  - 1. Pipe insulation.
  - 2. All Valves.
  - 3. Plumbing fixtures and trim.
  - 4. Pipe and pipe fittings.
  - 5. PVC jacket color samples.
  - 6. Water Heaters.
  - 7. Mixing Valves.
  - 8. Acid waste piping and fittings.

9. Pumps.
10. Backflow preventors.
11. Sewer Lift Stations.
12. Sewer Treatment Plants.
13. Grease Traps and Interceptors.
14. Oil and Water Separators.

## PART 2 - PRODUCTS

### 2.1 PLUMBING PRODUCTS

- A. Refer to individual Division 22 sections for plumbing products, pipe, tube and fitting materials and joining methods.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S DIRECTION

- A. The contractor shall install and operate equipment and material in accordance with the manufacturer's installation and operating instructions. The manufacturer's instructions of installation and operation shall become part of the Contract Documents and shall supplement the Drawings and Specifications.
- B. Store equipment in a clean, dry place protected from other construction. While stored, maintain factory wrapping or tightly cover and protect equipment against dirt, water, construction debris, chemical, physical or weather damage, traffic and theft.

### 3.2 EQUIPMENT LABELS

- A. Provide equipment labels for water heaters and mixing valves. Labels shall have permanent laminated construction secured to equipment.

### 3.3 PIPE LABELS

- A. Provide pipe markers and directional arrows on all piping in mechanical equipment rooms, or which is exposed in building, and on both sides of all valves located above ceiling. Markers shall be as manufactured by W.H. Bradley Co., Marking Services Inc. or the equivalent. All letters shall be color-coded and sized as recommended by OSHA. Samples of the type of letters to be used shall be submitted with shop drawings. Piping shall be color-coded.
- B. Pipe markers with arrows shall indicate lines content and shall be located 20 feet on center and at each change of direction of line. Identification bands shall be color coded to match pipe markers and shall be provided 10 feet on center. Pipe identification markers shall be taped at each end and shall be taped around the entire circumference of pipe.

C. The following Piping shall be identified:

1. Domestic Cold Water
2. Domestic Hot Water
3. Domestic Hot Water Return
4. Natural Gas
5. Sanitary Sewer
6. Sanitary Vent
7. Storm Drainage
8. Acid Vent
9. Condensate Drain
10. Condensate Return

### 3.4 VALVE TAGS

A. Secure metal tags to all valves. Labeling on all valve tags shall include type of system the valve controls and the area of building, zone, or equipment number affected by valve operation. Tag shall be 2" minimum diameter brass, engraved with code number, service and size. A framed list of the valves, giving manufacturer's name, model number, type and location shall be mounted in the main equipment room.

### 3.5 ACCESS DOORS:

A. Provide access doors in walls, floors and ceilings to permit access to equipment and piping requiring service or adjustment.

1. Valves.
2. Plumbing drainage cleanouts.
3. Other Plumbing equipment indicated in schedules or specifications which are requiring maintenance, adjustment or operation.

B. Provide hinged access doors and frames as follows:

1. Drywall Construction:
  - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel.
  - b. Provide prime paintable surface (not galvanized).
  - c. Product: Milcor "Style M" (Karp DSC-214M).
2. Visible Masonry and Ceramic Tile:
  - a. Milcor "Style M" (Karp DSC-214M).
3. Cement Plaster:
  - a. Milcor "Style K" (Karp DSC-214 PL).
4. Acoustical Plaster:
  - a. Reinforced panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sufficient number for the size of the panel. Provide factory prime paint surface (not galvanized).
  - b. Product: Milcor "Style AP" (Karp 214 PL).
5. Acoustical Tile:
  - a. Milcor "Style AT" (Larsen L-CPA).

C. Provide continuous concealed hinges and cam locks.

- D. Provide UL listed 1-1/2 hour label "B" access doors with automatic self-closing latching mechanism where required.
- E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.
- F. Coordinate approval of type, color and location of access doors & frames with Architect.

### 3.6 CLEANING AND SERVICE

- A. Upon Completion of this work, the contractor shall clean and adjust equipment, controls, valves, etc.;
- B. Clean piping, fixtures, cleanout covers, floor drain covers, etc. and leave the entire installation in good working order.
- C. Adjust flush valves and faucets to allow for proper operation.

END OF SECTION 23 00 00

## SECTION 22 05 23 – GENERAL DUTY VALVES FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes the furnishing and installation of general duty valves for plumbing:

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372 (lead free).

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and soldered ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.

2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.5 for flanges on steel valves.
  4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  5. ASME B16.18 for solder-joint connections.
  6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  2. Hand lever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
  2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  3. Memory stops that are fully adjustable after insulation is applied.

## 2.2 MANUFACTURERS

- A. Valves shall be manufactured by one of the following:
1. Kitz.
  2. Red & White.
  3. Nibco.
  4. Kennedy.
  5. Crane.
  6. Milwaukee.
  7. Keystone.
  8. Stockham.
  9. Grinnell.
  10. Mueller.
  11. Jamesbury.
  12. DeZurik.
  13. Hammond.
  14. Apollo.

## 2.3 BRONZE BALL VALVES

- A. Two-Piece, Bronze Ball Valves with Full Port and Brass Trim:
1. Kitz 59/69, Apollo 77C, NIBCO Design S-580-70, Milwaukee BA-150-S, Red & White 5049F or equal, threaded ends of heating hot water and low pressure steam of Kitz 58/68,

Apollo 77CLF, NIBCO Design T-580-70, Milwaukee BA-100-S, Red & White 5044F or equal. For insulated piping systems, provide ball valves with extended stem, insulated handle with protective thermal barrier sleeve to prevent condensate moisture drip and pipe insulation deterioration.

2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. SSP Rating: 150 psi.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded and soldered.
  - g. Seats: PTFE.
  - h. Stem: Brass. Blow-out proof.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.
  - k. Vinyl covered steel handle.
  - l. Lead Free.
  - m. Conforms to ASTM B-62.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Unions are not required on flanged devices.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install valve tags.
- F. All valves, unions, etc. where pipe is chrome plated shall have similar finish. All exposed supplies to plumbing fixtures shall be chrome plated.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. All gas cocks, valves, etc. on gas lines shall have local utility company and AGA approval.
- C. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Solder ends, except provide threaded ends for heating hot water.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends or grooved ends.
  - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Grooved end or Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5 and Larger: Grooved end or Flanged ends.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 3 and Smaller (above grade):
  - 1. Two-piece, bronze ball valves with full port and brass trim.
- B. Domestic water valves (below grade):
  - 1. M & H AWWA Series C-509, NIBCO T113 (3/4" to 2"), NIBCO T619 (2-1/2" and above) resilient gate valve with low torque operation, positive shut-off, O- Ring seals, full epoxy coating and square valve stem end.
  - 2. Provide two (2) adjustable "TEE" handle valve wrenches to be turned over to the owner after construction is complete.

END OF SECTION 22 05 23

## SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe positioning systems.
  - 9. Equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Equipment supports.
  
- C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. **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:
  - a. [B-line, an Eaton business.](#)
  - b. [Flex-Strut Inc.](#)
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

## 2.4 THERMAL-HANGER SHIELD INSERTS

- 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. [Buckaroos, Inc.](#)
  2. [Carpenter & Paterson, Inc.](#)
  3. [Clement Support Services.](#)
  4. [National Pipe Hanger Corporation.](#)
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.6 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:

1. Attach clamps and spacers to piping.
  - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

- F. Use **[stainless-steel pipe hangers]** **[and]** **[fiberglass pipe hangers]** **[and]** **[fiberglass strut systems]** and **[stainless-steel]** **[or]** **[corrosion-resistant]** attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  1. Domestic cold-water piping.
  2. Domestic hot-water piping.
  3. Sanitary drain piping receiving condensate.
  4. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated and for each application. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied, if any).

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. Reject damaged, deteriorated, wet, or contaminated material and immediately remove from the site. Replace removed materials at no additional cost to Owner.

## 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Insulation:
  - 1. Pittsburgh-Corning.
  - 2. Owens- Corning.
  - 3. Certainteed.
  - 4. Armacell.
  - 5. Rubatex.
  - 6. Knauf.
  - 7. Johns Manville.
- B. Jacketing:
  - 1. Ceel-Co.
  - 2. O'Brien.
  - 3. Zeston.
  - 4. Childers.
  - 5. Pabco.
- C. Adhesives:
  - 1. Benjamin Foster.
  - 2. Childers.
  - 3. Vimasco.
  - 4. B.E.H.

## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Density of 5.0 lbs/cubic foot.
  - 2. K factor of 0.27 at 75 degrees F mean.
  - 3. Maximum water vapor transmission of 0.17 per inch.
  - 4. Must be listed for 25/50 flame/smoke spread of thickness used.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. All-service jacket ASJ-SSL type factory applied jacketing.
  - 2. 6 lbs/cu ft minimum density.
  - 3. k-factor of 0.31 maximum at 200 degrees F mean.
  - 4. 850 degree F service temperature.
  - 5. 0.02 perm maximum Jacket permeance.

## 2.3 PIPE AND FITTING COVERS

- A. Polyvinyl Chloride (PVC) Covers:
  - 1. Ultraviolet resistant.
  - 2. 0.020 inch minimum thickness.
  - 3. Preformed to match outer diameter of insulation.
  - 4. Preformed fitting covers, minimum 10 mil.
- B. Aluminum (A) Covers:
  - 1. ASTM B209, Alloy 3003 minimum.
  - 2. 0.016-inch thickness.
  - 3. Bright anodized or acrylic-coated smooth finish on exposed side.

4. 2-piece tee and ribless elbow covers in minimum 0.016-inch, preformed.
5. Provide moisture barrier backing and butt-joint with mastic seal for joining of adjacent sections.

## 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.5 MASTICS

- A. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  2. Service Temperature Range: 0 to 180 deg F.
  3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  4. Color: White.

## 2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  3. Service Temperature Range: 0 to plus 180 deg F.
  4. Color: White.

## 2.7 SEALANTS

- A. Joint Sealants:
  1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 100 to plus 300 deg F.
  4. Color: White or gray.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

## 2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

## 2.10 SECUREMENTS

- A. Bands:
  1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

## 2.11 PROTECTIVE SHIELDING GUARDS

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water Mains:
  - 1. NPS 2 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 2-1/2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Domestic Hot Water Supply and Return runouts (up to NPS 2 and not exceeding 12 feet in length from fixture shutoff valve back toward main line):
  - 1. NPS 2 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- D. Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities (Handicapped Lavatory & Sinks P-Trap & Supply Lines):
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Insulate p-trap, tailpiece and water supplies on handicapped lavatories with white, Truebro Model 102, Zurn 8947 handi lav-guard, or approved equivalent insulating system to meet A.D.A. Requirements. Provide accessories for offset tailpiece as required.
    - b.
    - c.
- E. Floor Drains, Traps, and aboveground Sanitary Drain Piping receiving HVAC condensate:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Mineral-Fiber, 3/4 lb density, ductwrap insulation with aluminum foil vapor barrier, Type I: 2 inch thick.
- F. Exposed Domestic Cold and Hot Water Piping.
  - 1. All exposed domestic cold and hot water piping shall also have field install PVC jacket.

G. Sewer Waste and Vent Piping:

1. Where Contractor elects to use schedule 40 PVC waste and vent piping (in lieu of cast iron piping) (exposed, in walls, in furrings, or above ceilings) (vertical and horizontal lines) shall be insulated with 2" thick 3/4 # density fiberglass ductwrap insulation with aluminum foil vapor barrier. Insulation shall be sealed at all seams and joints. Insulation shall be installed with a foil backed adhesive tape around the diameter of the pipe with insulation at 24" on center intervals.

3.12 INDOOR, PIPING WITHIN CMU BLOCK WALLS PIPING INSULATION SCHEDULE

- A. Domestic cold water, hot water and condensate drain lines shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant. Engineered Polymer Foam Insulation (EPFI) will not be accepted.

3.13 INDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Domestic cold and hot water lines run below slab within building shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal.
- B. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant.
- C. Engineered Polymer Foam Insulation (EPFI) will not be accepted.
- D. Apply two (2) coats of mastic on insulation.

3.14 OUTDOOR, ABOVE GROUND PIPING INSULATION SCHEDULE

- A. All water lines on the outside of the building exposed to the weather shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal.
- B. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant.
- C. Engineered Polymer Foam Insulation (EPFI) will not be accepted.
- D. Apply two (2) coats of mastic on insulation.
- E. Lines shall be covered with 0.016 smooth aluminum jacket and elbows. At contractor's option, in lieu of 0.016 aluminum jacket, the contractor may use Venture Clad 1577CW multi-layered laminate coated, acrylic pressure sensitive adhesive jacket system.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
  - 2. Encasement for piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For piping, transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

## 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- C. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Lead free Solder-joint.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.5 AT CONTRACTOR'S OPTION, PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX-a Tube:
  - 1. Metal insert Crimp ASTM F 1807: metal-insert type with copper or stainless-steel crimp rings and matching PEX-a tube dimensions.
  - 2. Cold Expansion ASTM F 1960: Lead-free brass or engineered polymer (EP) fittings manufactured by the pipe manufacturer, utilizing cold-expansion PEX-a reinforcing rings made of same material as the pipe. Fittings shall be third party certified to NSF-14, and ASTM-F1960 and shall comply to ASTM-F876 & ASTM-F877.
    - a. Flanges: ASME B16.5, Class 150, with ASTM F1960 cold-expansion end.
    - b. Groove Adapter: One CSA B242-05 groove end and one ASTM F1960 cold-expansion end.
    - c. Press: PEX-a to Press One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 150 psig.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 220000 "Plumbing General Provisions" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors.
- N. Install sleeve seals for piping penetrations of concrete walls and slabs.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- P. Domestic cold water lines penetrating concrete slabs shall be wrapped with "Protect-O-Sleeve" vinyl flexible tube as manufactured by Robert H. Harris Co., Jones Stephen or equivalent.

- Q. PEX-a piping shall be installed per ASTM E84 requirements for plenum applications. Install all PEX-a pipe support and provide all required hangers and supporting strapping as required by manufacturer to provide a code compliant installation.
- R. Install PEX-a piping in straight runs free of kinks, provide bend supports at all pipe drops. All PEX-a piping penetrations through wall plates shall be protected or shielded as required to prevent damage to piping.
- S. Install PEX-a piping from the manifold to each fixture as a home run, not taps, tees or branches shall be permitted between the manifold and the fixture.
- T. Install PEX-a Pipe Support, fixed anchor points and hangers in compliance with the Uponor Commercial Piping Pocket Guide (2017).
- U. PEX-a shall not be installed in areas within five feet of UV light unless protected.
- V. Install piping in compliance with manufacturer's Commercial Piping Pocket Guide (2017).
- W. Install PEX-a piping at each fixture with out of the wall support bracket to secure piping and prevent excess movement when water stops or shut valves are operated.
- X. Install all PEX Manifolds centered in access panels to permit servicing.

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Joints for PEX Piping: Join according to ASTM F 1807 or ASTM F1960

### 3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition unions.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Provide pipe hangers and support products. Install as per the following:
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
  - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- G. Install vinyl-coated hangers for PEX-a piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. Crosslinked Polyethylene PEX-a Pipe: Install hangers for PEX tubing in strict accordance with manufactures instructions.

- a. Horizontal PEX-a Piping Hangers: Install CTS hangers suitable for PEX-a piping in compliance with the Uponor Commercial Piping Pocket Guide (2017) and local codes, with the following maximum spacing:
    - b. For IPC Jurisdictions: 3 inch and below: Maximum span, 32 inches.
    - c. For UPC Jurisdictions: 1 inch and below: Maximum span, 32 inches.
    - d. For UPC Jurisdictions: 1-1/4 inch and above: Maximum span, 48 inches.
    - e. Note: The above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.
  - 2. Horizontal PEX-a Piping with PEX-a Pipe Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
    - a. 3/4 inch and below: Maximum span, 6 feet.
    - b. 1 inch and above: Maximum span, 8 feet.
- H. Install hangers for vertical PEX piping every 48 inches.
- 1. Vertical PEX-a Piping: Support PEX-a piping with maximum spacing of 5 feet.
- I. PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor for domestic hot-water systems. Install mid-story guides between each floor. Install CTS riser clamps at the base of each floor and at the top of every fourth floor for domestic cold-water systems. Install mid-story guides.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.7 IDENTIFICATION

- A. Identify system components.

### 3.8 FIELD QUALITY CONTROL

#### A. Perform the following tests and inspections:

##### 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

##### 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

#### B. Domestic water piping will be considered defective if it does not pass tests and inspections.

#### C. Prepare test and inspection reports.

### 3.9 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of available chlorine. Isolate with valves and allow to stand for 24 hours (minimum time shall be 6 hours). A chlorine residual of at least 5 ppm should remain before the lines are put in use.
  3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - a. Repeat procedures if biological examination shows contamination.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction.

- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Underground piping up to 5'-0" from building, domestic cold water, building-service piping, NPS 4 and smaller, shall be the following:
  - 1. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
- E. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; copper, solder-joint fittings; and soldered joints.
- F. Under-building-slab, domestic water piping, 3" and smaller, shall be the following:
  - 1. PEX-a tube, 3" and smaller; fittings for PEX-a tube with cold expansion ASTM F1960 connection.
- G. Aboveground domestic water piping, 2" and smaller, shall be the following:
  - 1. PEX-a tube, 2" and smaller; fittings for PEX-a tube with cold expansion ASTM F1960 connection.
- H. Aboveground domestic water piping, 2-1/2" to 4", shall be the following:
  - 1. PEX-a tube, 3" and smaller; fittings for PEX-a tube with cold expansion ASTM F1960 connection.

### 3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball valves for piping NPS 3 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 4 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Vacuum breakers.
  2. Water-hammer arresters.
  3. Escutcheons
  4. Trap-seal primer valves.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.
- B.

## 2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Standard: ASSE 1001.
  - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 3. Body: Bronze.
  - 4. Inlet and Outlet Connections: Threaded.
  - 5. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011.
  - 2. Body: Bronze, non-removable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: Chrome or nickel plated.

## 2.4 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
  - 1. 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:
    - a. AMTROL, Inc.
    - b. Precision Plumbing Products.
    - c. Sioux Chief Manufacturing Company, Inc.
  - 2. Standard: ASSE 1010 or PDI-WH 201.
  - 3. Type: Copper tube with piston.
  - 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.
  - 5. Plumbing fixtures with quick closing valves (i.e.: Dishwashers, Ice Maker, Tub/Shower Valve, Washing Machines, etc.) install "Shock Trol", "Precision Plumbing Products", Sioux Chief "Hydra-Rester", or equal water Hammer arrester properly sized for each unit.

## 2.5 ESCUTCHEONS

- A. Provide escutcheons for all exposed lines passing through floors, walls, and ceilings. They shall be chrome plated brass and shall be of such flange size as to cover necessary penetrating openings.

## 2.6 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
  - 1. Standard: ASSE 1018.
  - 2. Pressure Rating: 125 psig minimum.
  - 3. Body: Bronze.
  - 4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  - 5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  - 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

- B. Drainage-Type, Trap-Seal Primer Device:
  - 1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
  - 2. Size: NPS 1-1/4 minimum.
  - 3. Material: Chrome-plated, cast brass.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install water-hammer arresters in water piping according to PDI-WH 201.
- B. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- C. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

END OF SECTION 22 11 19

## SECTION 22 13 16 – SANITARY WASTE, GREASE WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Stainless-steel drainage pipe and fittings.
  - 2. PVC pipe and fittings.
- B. Related Requirements:
  - 1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
  - 2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, and details.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

## 1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  1. Soil, Waste, and Vent Piping: 10-foot head of water.
  2. Waste, Force-Main Piping: 50 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

### 2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 STAINLESS-STEEL DRAINAGE PIPE AND FITTINGS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  1. [Anvil International/Smith-Cooper International; Tailwind Capital, LLC.](#)
  2. [BLÜCHER; A Watts Water Technologies Company.](#)
  3. Josam Company.
- B. Description: Comply with requirements of ASME A112.3.1, drainage pattern.
- C. Material: Type 316L stainless steel
- D. Pipe Construction: Seamless.
- E. Internal Sealing Rings: EPDM.
- F. Joints: Single or double, socket and spigot ends.

## 2.4 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40 **will not be accepted**.
- D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
- E. PVC Pressure Fittings: ASTM D 2466, Socket Type
- F. Primer: ASTM F 656.
  - 1. Primer shall have a VOC content of 550g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
  - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers"
- G. Solvent Cement: ASTM D 2564.
  - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers"

## 2.9 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Mission Rubber Company, LLC; a division of MCP Industries.
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.
    - e. Sleeve Materials:

- 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [Cascade Waterworks Mfg. Co.](#)
    - 2) [Mission Rubber Company, LLC; a division of MCP Industries.](#)
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
4. Pressure Transition Couplings:
- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [Apollo Valves; a part of Aalberts Integrated Piping Systems.](#)
    - 2) [EBAA Iron Sales, Inc.](#)
    - 3) [Romac Industries, Inc.](#)
  - b. Standard: AWWA C219.
  - c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  - d. Center-Sleeve Material: Manufacturer's standard.
  - e. Gasket Material: Natural or synthetic rubber.
  - f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [A.Y. McDonald Mfg. Co.](#)
    - 2) [WATTS; A Watts Water Technologies Company.](#)
    - 3) [Wilkins.](#)
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: **150 psig (1035 kPa).**
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [Capitol Manufacturing Company.](#)
    - 2) [WATTS; A Watts Water Technologies Company.](#)
    - 3) [Zurn Industries, LLC.](#)
  - b. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.
    - 3) Pressure Rating: **150 psig (1035 kPa).**
    - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
3. Dielectric-Flange Insulating Kits:
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [Advance Products & Systems, LLC.](#)
    - 2) [CALPICO, Inc.](#)
    - 3) [GF Piping Systems: Georg Fischer LLC.](#)
    - 4) [GPT; a division of EnPRO Industries.](#)
  - b. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: **150 psig (1035 kPa).**
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
4. Dielectric Nipples:
  - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - 1) [Anvil International/Smith-Cooper International; Tailwind Capital, LLC.](#)
    - 2) [Precision Plumbing Products.](#)
    - 3) [Victaulic Company.](#)
  - b. Description:
    - 1) Standard: IAPMO PS 66.
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: **300 psig (2070 kPa) at 225 deg F (107 deg C).**
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

## 2.13 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film manufactured of virgin polyethylene material conforming to the requirements of ASTM D 1248, and a minimum thickness of 0.008-inch thickness or, high-density, cross-laminated polyethylene film manufactured of virgin polyethylene material conforming to the requirements of ASTM D 1248, and a minimum thickness of 0.004-inch.
- C. Form: Sheet or, Tube
- D. Color: Black or, Natural
- E. Install polyethylene encasement for Hubless, Service, and Extra Heavy DWV cast iron pipe and fitting systems in accordance with ASTM A74, X3, and CISPI Handbook.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; 1 percent downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install steel piping according to applicable plumbing code.
- N. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Install engineered soil and waste and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  - 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
  - 3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- S. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

- T. Install force mains at elevations indicated.
- U. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping.
    - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
  - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
  - 4. In Underground Force Main Piping:
    - a. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type transition couplings.
    - b. **NPS 2 (DN 50)** and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric unions.
  - 3. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges.
  - 4. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install gate or full-port ball valve for piping **NPS 2 (DN 50)** and smaller.
  - 3. Install gate valve for piping **NPS 2-1/2 (DN 65)** and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
    - c. Longer Than **100 Feet (30 m)** if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within **12 inches (300 mm)** of each fitting, valve, and coupling.
- E. All horizontal piping 5" and larger branch openings, or changes in direction shall be suitably restrained to prevent movement of joints and possible separation. Restraints can be field fabricated, or pre-engineered and manufactured.
- F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves with cleanout cover flush with floor.
  - 6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 7. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections **NPS 2-1/2 (DN 65)** and larger.
- D. Connect force-main piping to the following:
  - 1. Sanitary Sewer: To exterior force main.
  - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water (30 kPa)**.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

- a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa).
  - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
  - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PREVENTIVE MAINTENANCE

- A. All piping coming from parking deck drains shall be flushed with clean water for not less than 10 minutes in each drain after winter season, and every 120 days. If chemicals are used to clean garage walls, this chemical shall be washed off the exterior of the pipe.
- B. All piping from dedicated soda station floor sinks shall be flushed by dumping a basin of 5 gallons of warm clean water every 3<sup>rd</sup> day into the floor sink.

- C. All piping connected to “low flow” fixtures shall be flushed with clean water by filling, and releasing a utility wash basin sink from the furthest point possible not less than once every 7 days.

### 3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, sanitary waste piping **NPS 4 (DN 100)** and smaller shall be any of the following:
  - 1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping **NPS 4 (DN 100)** and smaller shall be any of the following:
  - 1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, sanitary waste, grease waste, and vent piping **NPS 4 (DN 100)** and smaller shall be any of the following:
  - 1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, grease waste piping **NPS 4 (DN 100)** and smaller shall be any of the following:
  - 1. Type 316L austenitic stainless steel Push-Fit piping and fittings. Sealing rings Push-Fit gaskets shall be of Ethylene Propylene Diene Monomer rubber known as EPDM.

END OF SECTION 22 13 16

## SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Cleanouts.
  2. Floor drains.
  3. Roof flashing assemblies.
  4. Through-penetration firestop assemblies.
  5. Miscellaneous sanitary drainage piping specialties.
  6. Flashing materials.

#### 1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 HUB DRAIN (MARKED "HD"):

- A. Provide SureSeal Model SS2009V for 2" diameter condensate hub drains.

## 2.2 TRAP PRIMER VALVE:

- A. Precision Plumbing Products Model P-1/P-2 (Mifab M-500), with air gap supply Precision Plumbing Products AG-500 (Mifab MI-GAP). Provide Precision Plumbing Products Distribution Unit (DU) (Mifab MI-DU) with proper number of branch lines as indicated on plans.

## 2.3 CLEANOUTS:

- A. Cleanouts other than type listed below as manufactured by J.R. Smith, Josam, Zurn and Wade, will not be acceptable.
- B. Cleanouts shall be provided where shown on plans, at each change of direction of the building drain greater than 45 degrees and at or near the foot of each vertical waste or soil stack. Location of all cleanouts shall be the same size as the piping. Every cleanout shall be installed so that the cleanout opens in the direction of the flow of the drainage line or at right angle thereto.
- C. Floor cleanouts shall be an adjustable type with anchor flange for clamp device, clamping collar and nickel bronze cover. Contractor shall install 2# lead flashing a minimum of 18" all around cleanout and flash into flange and anchor with clamping collar.
- D. Top of cleanout shall be level with top of finished floor so there is a continuous surface.
- E. Floor cleanouts shall be Zurn 1400, Wade W-6000, or J.R. Smith 4031 (NB) with adjustable scoriated secured nickel bronze top.
- F. Wall cleanouts shall be nickel bronze access frame and cover, Josam 58770, Wade W-8560-E with W-8303-1, J. R. Smith 4735 access cover.
- G. Outside cleanouts shall be as detailed on the Plans.

## 2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
  - 1. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
    - a. Open-Top Vent Cap: Without cap.

## 2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
  - 1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
  - 2. Size: Same as connected soil, waste, or vent stack.
  - 3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
  - 4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
  - 5. Special Coating: Corrosion resistant on interior of fittings.

## 2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
  - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
  - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.

### 3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

## SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Commercial, electric, storage, domestic-water heaters.
  - 2. Domestic-water heater accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of framed stands / bases with actual equipment provided.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: Three years.
    - b. Compression Tanks: Five years.

## PART 2 - PRODUCTS

### 2.1 DOMESTIC-WATER HEATER ACCESSORIES

- A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- C. Heat-Trap Fittings: ASHRAE 90.2.
- D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 50-psig- maximum outlet pressure unless otherwise indicated.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

## PART 3 - EXECUTION

### 3.1 CONNECTIONS

- A. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 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.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Prepare test and inspection reports.

### 3.3 WATER HEATER BOILER INSPECTION

- A. Contractor shall install water heaters to conform to Louisiana Boiler Inspection Law. Contractor shall contact the State Fire Marshal Boiler Inspection Division (800-256-5452) to get a final inspection on all water heaters 50 gallon capacity or larger and / or 100,000 BTU/HR heat input or greater.

END OF SECTION 22 33 00

## SECTION 22 42 00 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Floor drains.
  2. Water closets.
  3. Flush valves.
  4. Toilet seats.
  5. Urinals.
  6. Lavatories.
  7. Sinks.
  8. Hose bibs.
  9. Electric Water Cooler.
  10. Ice Machine Connection.
  11. Refrigerator water connection box.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each of the plumbing fixtures.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flush valves to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

- 2.1 REFER TO PLUMBING FIXTURE SCHEDULE IN DRAWINGS FOR ADDITIONAL INFORMATION.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Refer to Architectural Drawings for mounting height and exact location of all plumbing fixtures. Handicapped fixtures shall be installed to meet the latest A.D.A. requirements.

### 3.3 QUALITY

- A. Plumbing Contractor shall furnish and install all plumbing fixtures shown on accompanying Drawings. Refer to both Plumbing and Architectural, and provide all fixtures shown on either. Fixtures shall be complete with all necessary brass and accessories required for a complete installation, including traps, escutcheons, angle supplies, basin cocks, etc. All fixtures shall be new and must be delivered to the building properly crated in perfect condition.
- B. All brass must be of the best quality. Lightweight goods will not be accepted.
- C. All brass pipe shall be seamless brass tubing and nipples shall be extra heavy.
- D. All fittings and trim shall be chromium plated heavy brass unless otherwise specified.
- E. "P" traps on lavatories and sinks shall be cast brass with cleanouts.
- F. All exposed piping shall be chromium plated.
- G. Provide cut-off valves at each fixture in both hot and cold water piping.
- H. For the purpose of establishing type and class of fixtures required, the following plate numbers have been taken from the Manufacturer's Catalog as indicated: Other fixture manufacturer's and model numbers, with prior approval, will be acceptable, however fixtures and accessories shall meet standards and features indicated below.

- I. Contractor shall install silicon caulk around the base of a plumbing fixture or around the perimeter of a plumbing fixture where it attaches to a wall. The color of the caulk shall match the color of the plumbing fixture or shall be a color selected by the architect. Verify final color prior to installation. Caulked joint shall be properly smoothed out and shall completely seal the joint between the plumbing fixture and the surface the fixture is attached to. Unacceptable applications shall be completely removed and re-applied in accordance with directions from the architect.
- J. Water-Closet Installation:
  - 1. Install level and plumb according to roughing-in drawings.
  - 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  - 3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
- K. Support Installation:
  - 1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
  - 2. Use carrier supports with waste-fitting assembly and seal.
  - 3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
  - 4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- L. Flushometer-Valve Installation:
  - 1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
  - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  - 3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
  - 4. Install actuators in locations that are easy for people with disabilities to reach.
  - 5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- M. Install toilet seats on water closets.
- N. Wall Flange and Escutcheon Installation:
  - 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
  - 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
  - 3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
  - 4.
- O. Joint Sealing:
  - 1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
  - 2. Match sealant color to water-closet color.
  - 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.4 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.5 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

### 3.6 CLEANING AND PROTECTION

- A. Clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed plumbing fixtures and fittings.
- C. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

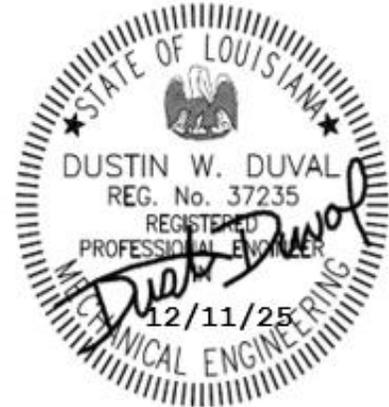
END OF SECTION 22 42 00

## SECTION 23 00 00 – MECHANICAL GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The General Conditions of the Architectural Specifications, along with the supplementary conditions, special conditions, information to bidders, and any other pertinent information and documents shall apply the same as if repeated herein.



#### 1.2 SCOPE OF WORK

- A. Furnish all labor and material necessary to provide and install the complete mechanical portion of this Contract, including HVAC systems as called for herein and on accompanying drawings. Parts of the mechanical division may be bid separately or in combination, at the Contractor's option; however, it shall be the responsibility of the General Contractor to assure himself that all items covered in this Division have been included if he chooses to accept separate bids.
- B. This Contractor shall refer to the Architectural and Structural drawings and install equipment, piping, etc. to meet building and space requirements. No equipment shall be bid on or submitted for approval if it will not fit in the space provided.
- C. It is the intention of these Specifications that all mechanical systems shall be furnished complete with all necessary valves, controls, insulation, piping, devices, equipment, etc. necessary to provide a satisfactory installation in working order.
- D. Contractor shall visit the site and acquaint himself thoroughly with all existing facilities and conditions that would affect his portion of the work. Failure to do so shall not relieve the Contractor from the responsibility of installing his work to meet the conditions.
- E. This Contractor shall protect the entire system and all parts thereof from injury throughout the project and up to acceptance of the work. Failure to do so shall be sufficient cause for the Architect to reject any piece of equipment.

#### 1.3 DEMOLITION

- A. The contractor shall visit the site prior to bid to determine the extent of work required to complete the project.
- B. Contractor shall coordinate demolition with owner. The Owner shall have "First Right of Refusal" regarding salvage of all equipment and materials to be removed. Locate equipment as directed by owner. All equipment and materials not salvaged by the owner shall be removed from the site and discarded at the contractor's expense.
- C. Contractor shall coordinate all work with general contractor and phase work as required by project.

- D. All equipment piping, etc. required to be removed to accommodate the modifications shall be removed.
- E. Contractor shall maintain services to existing facilities which shall remain during and after construction is complete.
- F. Contractor shall coordinate any shutdown of services with the owner. It is intended that the building will remain occupied during construction. Contractor shall schedule shut down of services with the owner in order to prevent disruption of building occupancy.
- G. Contractor shall be responsible for draining down of existing systems to complete demolition. All work shall be scheduled with the owner. Contractor shall also be responsible for refilling system and removing all air in order to return the systems to proper operating conditions.
- H. All shut down of services shall be done at night or during a time period approved by the owner. The systems shall be required to be back up and running each morning unless otherwise approved by the owner.

#### 1.4 GROUNDS AND CHASES

- A. This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of his work are properly built in as the work progresses; otherwise, he shall bear the cost of providing them.

#### 1.5 CUTTING AND PATCHING

- A. Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor being responsible for laying out and marking any and all holes required for the reception of his work. No structural beams or joists shall be cut or thimble without first receiving the approval of the Architect. After initial surfacing has been done, any further cutting, patching and painting shall be done at this Contractor's expense.

#### 1.6 FILL AND CHARGES FOR EQUIPMENT

- A. Fill and charge with materials or chemicals all those devices or equipment as required to comply with the manufacturer's guarantee or as required for proper operation of the equipment.

#### 1.7 MACHINERY GUARDS

- A. This Contractor shall provide v-belt guards for each v-belt drive or other hazardous drive. The guard shall enclose the drive entirely and shall have a hole for taking a tachometer reading.
- B. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys and other rotating parts which are located such that a person might come in close proximity. Construct protective guard around angle iron frame, securely bolted to apparatus; comply with safety requirements. Install guard to completely enclose drives and pulleys and not interfere with lubrication of equipment. Provide 2 inch minimum diameter opening in fan belt guards housing for tachometer.

## 1.8 REPAIRING ROADWAYS AND WALKS

- A. Where this Contractor cuts or breaks roadways or walks, in order to lay piping, he shall repair or replace these sections to meet the Architect's approval.

## 1.9 EXCAVATION AND BACKFILL

- A. Contractor shall perform all excavating necessary to lay the specified services. Perform excavation of every description and of whatever substance encountered to depths indicated or specified. Pile materials suitable for backfilling a sufficient distance from banks of trenches to prevent slides or cave-ins. Comply with OSHA requirements for excavation, trenching and shoring. Waste excavation materials, rubbish, etc. shall be carted away from the premises, as indicated. Remove water from trenches by pumping or other approved method, discharge at a safe distance from the excavation.
- B. Provide trenches of necessary width for proper laying of pipe and comply with latest publication of OSHA 2226 Excavating and Trenching Operations. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods. Accurately grade bottoms of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil or the required thickness of bedding material at every point along its entire length.
- C. Provide minimum 12 inches between outer surfaces and embankment or shoring, which may be used, when excavating for manholes and similar structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.
- D. Material to be excavated is "unclassified". No adjustment in the contract price will be made on account of the presence or absence of rock, shale, masonry, or other materials.
- E. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines encountered during excavating and trenching operations, from damage during excavating, trenching and backfilling; if damaged, repair lines as directed by utilities, owner and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.
- F. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grades, or depths of cover in accordance with the manufacturer's recommendations, whichever is lower:
  - 1. 3-Foot Minimum Cover: Chilled Water lines, Heating Hot Water Lines, Condenser Water Lines.
- G. Underground piping shall have a 6" bed of sand below the piping and backfilled with sand to 6" above the top of piping. Select fill may be used above the sand layer.
- H. Backfill trenches after piping, fittings and joints have been tested and approved. Backfill trenches with sand to provide 6 inches of sand below piping and 12 inches of sand cover above piping.

- I. Backfill remainder of trenches with satisfactory material consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones not over 1-1/2 inches in size. Deposit backfill material in 9 inch maximum layers, loose depth as indicated or as specified. Take care not to damage utility lines.
- J. Deposit the remainder of backfill materials in the trench in 1 foot maximum layers and compact by mechanical means. Refer to architectural for minimum density for compaction (Minimum 85 percent of maximum soil density as determined by ASTM D 698). Re-open trenches and excavation pits improperly backfilled or where settlement occurs to the depth required to obtain the specified compaction, the refill and compact with the surface restored to the required grade and compaction.
- K. Backfill utility line trench with backfill material, in 6 inch layers, where trenches cross streets, driveways, building slabs, or other pavement. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

#### 1.10 WELDING

- A. Weld piping and above grade steel tanks in accordance with qualified procedures using performance qualified welders and welding operators. Qualified procedures and welders in accordance with ASME Section IX. Welding procedures qualified by others and welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. Notify the A/E 24 hours in advance of tests, and perform the tests at the work site if practicable. Furnish A/E with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. Apply welders or welding operators assigned symbols near each weld they make as permanent record.

#### 1.11 NOISE AND VIBRATION

- A. Provide the plumbing system and its associated components, items, piping, and equipment free of objectionable vibration or noise. Statically and dynamically balance rotating equipment and mount or fasten so that no vibration is transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional compensation.

#### 1.12 PAINTING

- A. All painting shall be by the General Contractor's Painting Sub-Contractor. All pipe, pipe covering, equipment, supports, hangers, etc. exposed in the building or equipment room shall be painted. This Contractor shall prepare the surface of the material to receive the first coat of paint.
- B. All steel hydronic piping shall have two (2) coats of rust inhibitor primer applied prior to insulating.

- C. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded.
- D. All piping shall be color coded per the following:
 

1. Chilled Water Piping	Blue
2. Condenser Water Piping	Green
3. Hydronic Heating Hot Water Piping	Red
4. Ductwork (Exposed in Building)	Black

1.13 CLEANING AND ADJUSTING

- A. Upon completion of his work, the Contractor shall clean and adjust all equipment, controls, valves, etc.; clean all piping, ductwork, etc.; and leave the entire installation in good working order.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide the Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts lists, maintenance and repair instructions and test and balance report.
- B. COPIES OF SHOP DRAWINGS WILL NOT BE ACCEPTABLE AS OPERATION AND MAINTENANCE INSTRUCTIONS BUT MUST BE INCLUDED IN SUBMITTAL PACKAGE.
- C. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of equipment. Submit manuals to the Architect for approval.
- D. In addition to the operation and maintenance brochure, the Contractor shall provide a separate brochure which shall include registered warranty certificates on all equipment, especially any pieces of equipment which carry warranties exceeding one (1) year.
- E. The operation and maintenance brochure shall be furnished with a detailed list of all equipment furnished to the project, including the serial number and all pertinent nameplate data such as voltage, amperage draw, recommended fuse size, rpm, etc. The Contractor shall include this data on each piece of equipment furnished under this contract.

1.15 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the project. This guarantee shall include furnishing of all labor and material necessary to make any repairs, adjustments or replacement of any equipment, parts, etc. necessary to restore the project to first class condition. This guarantee shall exclude only the changing or cleaning of filters. Warranties exceeding one (1) year are hereinafter specified with individual pieces of equipment.

#### 1.16 LOCAL CONDITIONS

- A. The location and elevation of all utility services is based on available surveys and utility maps and are reasonably accurate; however, these shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his satisfaction in order to determine the amount of work required for the execution of the Contract.
- B. The Contractor shall contact the various utility companies, determine the extent of their requirements and he shall include in his bid all lawful fees and payments required by these companies for complete connection and services to the building, including meters, connection charges, street patching, extensions from meters to main, etc.
- C. In case major changes are required, this fact, together with the reasons therefor, shall be submitted to the Architect, in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions and expenses necessary for the successful completion of the project.

#### 1.17 PERMITS, INSPECTIONS AND TESTS

- A. All permits, fees, etc. for the installation, inspections, plan review, service connections locations, and/or construction of the work which are required by any authority and/or agencies having jurisdiction, shall be obtained and paid for by the Contractor. This shall be verified during the bidding process.
- B. The Contractor shall make all tests required by the Architect, Engineer or other governing authorities at no additional cost to the Owner.
- C. The Contractor shall notify the Architect and local governing authorities before any tests are made, and the tests are not to be drawn off a line covered or insulated until examined and approved by the authorities. In event defects are found, these shall be corrected and the work shall be retested.
- D. Prior to requesting final inspection by the Architect, the Contractor shall have a complete coordination and adjustment meeting of all of his sub-contractors directly responsible for the operation of any portion of the system. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Architect in writing ten (10) days prior to this meeting, instructing him of the time, date and whom you are requesting to be present.
- E. This project shall not be accepted until the above provisions are met to the satisfaction of the Architect.

#### 1.18 CODES AND STANDARDS

- A. The entire mechanical work shall comply with the rules and regulations of the City, Parish, County and State in which this project is being constructed, including the State Fire Marshal and the State Board of Health. All modifications required by these authorities shall be made without additional charge to the Owners. The Mechanical Contractor shall report these changes to the Architect and secure his approval before work is started.

- B. In addition to the codes heretofore mentioned, all mechanical work and equipment shall conform to the applicable portions of the following specifications, codes and/or regulations:
1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  2. National Electrical Code (NEC)
  3. National Fire Protection Association (NFPA)
  4. American Society of Mechanical Engineers (ASME)
  5. American Gas Association (AGA)
  6. International Building Code (IBC)
  7. International Mechanical Code (IMC)
  8. International Plumbing Code (IPC)
  9. International Fuel Gas Code (IFGC)
  10. Underwriters Laboratories (UL)
  11. Life Safety Code (NFPA 101)
  12. State Sanitary Code
  13. Louisiana State Uniform Construction Code Council (LSUCCC)
  14. Facility Guidelines Institute "Guidelines for Design and Construction of Hospitals and Outpatient Facilities" (2014 Edition)
- C. All materials, equipment and accessories installed under this Contract shall conform to all rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment and accessories. All materials shall be new and of the best quality and first class in every respect. Whenever directed by the Architect, the Contractor shall submit a sample for approval before proceeding.
- D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such equipment be furnished complete with the necessary accessories, whether or not called for in these Specifications.
- E. All unfired pressure vessels shall be built in accordance with the A.S.M.E. Code and so stamped. Furnish shop certificates for each vessel.

#### 1.19 REVIEW OF MATERIALS

- A. Whenever manufacturers or trade names are mentioned in these Plans or Specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only, and should not be construed to infer a preference. Equivalent products which meet the Architect's approval will be accepted; however, these products must be submitted to the Architect a minimum of seven (7) days prior to the Bid Date.
- B. Submission shall include the manufacturer's name, model number, rating table and construction features.
- C. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. **THE CONTRACTOR SHALL BASE HIS BID SOLELY ON THOSE ITEMS SPECIFIED OR INCLUDED IN THE "PRIOR APPROVAL ADDENDUM", AS NO OTHER ITEM WILL BE ACCEPTABLE.**

- D. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with the Plans and Specifications and that it will fit into the space provided. Shop drawings must be submitted on all items of equipment for approval as hereinafter specified.
- E. Before proceeding with work and/or within thirty (30) days after the award of the General Contract for this work, the Mechanical Contractor shall furnish to the Architect complete shop and working drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this project. These drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.
- F. The Architect's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other errors which may be contained in these drawings. Any omission from the shop drawings or specifications, even though approved by the Architect, shall not relieve the Contractor from furnishing and erecting same.
- G. If contractor submits hard copies, Six (6) sets of shop drawings shall be submitted to the Architect for approval. These submittals shall be supplied as part of this Contractor's contract.
- H. This information shall be bound in plastic hardbound notebooks with the job name on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of materials and equipment. Submit shop drawings to the Architect for approval. Faxed copies shall not be acceptable. We prefer electronic submissions sent via E-Mail.
- I. Required shop drawing submittals shall include but are not limited to the following:
  - 1. DX Split System Air Conditioning Equipment.
  - 2. VRF Air Conditioning Equipment.
  - 3. Packaged Air Conditioning Equipment.
  - 4. Grilles, registers, diffusers and louvers.
  - 5. Ductwork and duct sealer.
  - 6. Duct insulation and accessories.
  - 7. Controls/Building Automation System.
  - 8. Exhaust fans.
  - 9. Unit heaters.
  - 10. Packaged Terminal units.
  - 11. Double wall spiral pipe and fittings.
  - 12. Fan powered boxes.
  - 13. Variable air Volume Boxes / Terminal Units.
  - 14. Pumps.
  - 15. Boilers.
  - 16. Chillers.
  - 17. Cooling Towers.
  - 18. Energy recovery ventilators.
  - 19. Relief and intake hoods.
  - 20. Heat and Smoke Vents
  - 21. Fire dampers
  - 22. Smoke dampers.
  - 23. Combination Fire and Smoke Dampers
  - 24. Manual Dampers, Motorized Dampers and Control Dampers.
  - 25. Actuators.

26. Test and Balancing Agency (including forms).

#### 1.20 COORDINATION DRAWINGS

- A. Submit three (3) black line prints of all mechanical room layouts showing locations of all equipment, piping, etc. to insure all will fit in space provided. Submit drawings at 1/4" scale. Layouts shall include equipment submitted on project to scale on plans.
- B. Submit coordination drawings with the respective equipment shop drawings.

#### 1.21 MINOR DEVIATIONS

- A. Plans and detail sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes and manner of erecting work. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required. However, specified sizes and requirements necessary for satisfactory operation shall remain unchanged. It may be necessary to shift ducts or pipes, or to change the shape of ducts, and these changes shall be made as required. All such changes shall be referred to the Architect and Engineer for approval before proceeding. Extra charges shall not be allowed for these changes. The contractor shall obtain a full set of plans and specifications for the coordination of his work prior to bidding this project. Items which are unclear to the bidding contractor shall be brought to the Architect and Engineers attention prior to bidding the project. An interpretation shall be clarified by the Architect and/or the Engineer prior to bidding.
- B. The Contractor shall realize that the drawings could delve into every step, sequence or operation necessary for the completion of the project, without drawing on the Contractor's experience or ingenuity. However, only typical details are shown on the Plans. In cases where the Contractor is not certain about the method of installation of his work, he shall ask for details. Lack of details will not be an excuse for improper installation.
- C. In general, the drawings are diagrammatic and the Contractor shall install his work in a manner so that interferences between the various trades are avoided. In cases where interferences do occur, the Architect is to state which item was first installed.

#### 1.22 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall obtain at his cost, two sets of blackline prints of the original bid documents by the Architect. One set shall be kept on the site with all information as referenced below, and shall update same as the work progresses. The other set will be utilized to record all field changes to a permanent record copy for the Owner.
- B. If the Contractor elects to vary from the Contract Documents and secures prior approval from the Architect for any phase of the work, he shall record in a neat and readable manner, ALL such variances on the blackline print in red. The original blackline prints shall be returned to the Architect for documentation.

- C. All deviations from sizes, locations, and from all other features of the installations shown in the Contract Documents shall be recorded.
- D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions and the like, as well as other features of the work which will be concealed underground and/or in the finished building.
- E. Locations of underground work shall be established by dimensions to columns, lines or walls, locating all turns, etc., and by properly referenced centerline or invert elevations and rates of fall.
- F. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. The Architect's/Engineer's decision in this matter will be final.
- G. The following requirements apply to all "As-Built" drawings:
  - 1. They shall be maintained at the Contractor's expense.
  - 2. All such drawings shall be done carefully and neatly, and in a form approved by the Architect/Engineer.
  - 3. Additional drawings shall be provided as necessary for clarifications.
  - 4. These drawings shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by the Architect/Engineer; and when necessary, to establish clearances for other parts of the work.
  - 5. "As-built" drawings shall be returned to the Architect upon completion of the work and are subject to approval of the Architect/Engineer.

## PART 2 - PRODUCTS

### 2.1 HVAC SYSTEM PRODUCTS

- A. Refer to individual Division 23 sections for mechanical products, controls, fans, pipe, tube and fitting materials and joining methods.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S DIRECTION

- A. The contractor shall install and operate all equipment and material in accordance with the manufacturer's installation and operating instructions. The manufacturer's instructions of installation and operation shall become part of the Contract Documents and shall supplement the Drawings and Specifications.

### 3.2 EQUIPMENT LABELS

- A. Provide equipment labels for HVAC Equipment. Labels shall have permanent laminated construction secured to equipment.

- B. Provide laminated plate for each V.A.V. box or constant volume box. Attach plate to ceiling grid to indicate location above ceiling. Coordinate color selection with owner.
- C. Provide laminated plate for each VRF unit. For Ducted units above ceiling and refrigerant controllers (BC/BS)- Attach plate to ceiling grid to indicate location above ceiling. Plate shall be white with black letters. For ceiling recessed units – Attached plate within the filter compartment. Tag shall not interfere with the filter installation. Coordinate color selection with owner.

### 3.3 PIPE LABELS

- A. Provide pipe markers and directional arrows on all piping in mechanical equipment rooms, or which is exposed in building, and on both sides of all valves located above ceiling. Markers shall be as manufactured by W.H. Bradley Co., Marking Services Inc. or the equivalent. All letters shall be color-coded and sized as recommended by OSHA. Samples of the type of letters to be used shall be submitted with shop drawings. Piping shall be color-coded.
- B. Pipe markers with arrows shall indicate lines content and shall be located 20 feet on center and at each change of direction of line. Identification bands shall be color coded to match pipe markers and shall be provided 10 feet on center. Pipe identification markers shall be taped at each end and shall be taped around the entire circumference of pipe.
- C. The following Piping shall be identified:
  - 1. Heating Hot Water Supply
  - 2. Heating Hot Water Return
  - 3. Chilled Water Supply
  - 4. Chilled Water Return
  - 5. Condenser Water Supply
  - 6. Condenser Water Return

### 3.4 VALVE TAGS

- A. Secure metal tags to all valves. Labeling on all valve tags shall include type of system the valve controls and the area of building, zone, or equipment number affected by valve operation. Tag shall be 2" minimum diameter brass, engraved with code number, service and size. A framed list of the valves, giving manufacturer's name, model number, type and location shall be mounted in the main equipment room.

### 3.5 ACCESS DOORS:

- A. Provide access doors in walls, floors and ceilings to permit access to equipment and piping requiring service or adjustment.
  - 1. Valves.
  - 2. Manual balancing dampers and automatic control dampers.
  - 3. Air terminal units and VRF indoor units.
  - 4. Duct mounted filters and coils.
  - 5. Drainage cleanouts.
  - 6. Kitchen Hood exhaust ductwork in accordance with NFPA requirements.

7. Equipment shutoff protection devices such as disconnects, motor rated switches, etc.
8. Other mechanical equipment indicated in schedules or specifications which are requiring maintenance, adjustment or operation.

B. Provide hinged access doors and frames as follows:

1. Drywall Construction:
  - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel.
  - b. Provide prime paintable surface (not galvanized).
  - c. Product: Milcor "Style M" (Karp DSC-214M).
2. Visible Masonry and Ceramic Tile:
  - a. Milcor "Style M" (Karp DSC-214M).
3. Cement Plaster:
  - a. Milcor "Style K" (Karp DSC-214 PL).
4. Acoustical Plaster:
  - a. Reinforced panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sufficient number for the size of the panel. Provide factory prime paint surface (not galvanized).
  - b. Product: Milcor "Style AP" (Karp 214 PL).
5. Acoustical Tile:
  - a. Milcor "Style AT" (Larsen L-CPA).

C. Provide continuous concealed hinges and cam locks.

D. Provide UL listed 1-1/2 hour label "B" access doors with automatic self-closing latching mechanism where required.

E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.

F. Coordinate approval of type, color and location of access doors & frames with Architect.

### 3.6 CLEANING AND SERVICE

A. Upon Completion of this work, the contractor shall clean and adjust equipment, controls, valves, etc.;

B. Inspect, clean and service air filters and strainers immediately prior to final acceptance of project.

C. Provide complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced condition, check the charge and modify it for proper operation as required.

D. Place mechanical systems in complete working order. Clean equipment and piping materials thoroughly returning to "as new" condition prior to request for substantial completion.

E. Remove excess materials and debris from mechanical rooms and drain pans. Broom clean areas. Thoroughly clean ductwork inside and outside before air devices (diffusers, grilles, etc.) are installed.

### 3.7 TEMPORARY HEATING AND AIR CONDITIONING DURING CONSTRUCTION PHASE

- A. Permanent building air conditioning equipment or systems are not designed to control building temperature and humidity levels during construction of the building. The building's HVAC system is not designed nor is it well suited for the proper drying of building/construction materials, and should not be used for such purposes.
- B. At all times, during construction phases, provide temporary ventilation both for comfort and protection of workers, for proper drying of wet work, and for proper curing of installed materials. Follow material manufacturer's published instructions with regard to installation of building materials.
- C. Provide temporary heat both for the comfort and protection of workers and as necessary to ensure suitable working conditions for construction operations of construction trades, and also as necessary for storage of products and materials. Refer to material manufacturer's literature for environmental operational temperature and humidity requirements.
- D. Provide temporary heat by use of self-contained, vented portable heating units, employing tanked gas or other approved heat source.
- E. Use only heating apparatus and fuels labeled or listed by a "National Recognized Testing Laboratory" recognized by OSHA. Keep equipment and surroundings in clean, safe conditions.
- F. Use flame resistant tarpaulins other material for temporary enclosures of space.
- G. Provide temporary humidity control by the use of small incremental de-humidifiers, packaged desiccant type de-humidifiers, and/or packaged DX type air conditioners.
- H. Do not permit space temperatures to reach or fall to a level which will cause damage to work. Coordinate the temperature and humidity requirements with the manufacturer of the finishes being provided.
- I. Replace interior or exterior surfaces damaged by the use of temporary heaters with new materials or refinish at no additional expense to the owner.
- J. As soon as practical after permanent heating, ventilation, and air conditioning systems are in place and operable, the contractor at his option, may provide heat from the permanent building heating system, until such time that the building is complete. It is recommended that the building's permanent heating and air conditioning systems not be utilized to maintain temperature and humidity conditions within the building during the construction phase. Small space heaters and portable de-humidifiers are suggested as sources of temperature and humidity control. It is the intent that the permanent HVAC systems should not be used to condition or control humidity during construction.
- K. The use of permanent HVAC systems will require that the systems be complete and fully controllable by the Building Automation System (BAS) including the ability to remotely alarm proper maintenance personnel in the event of any and all system failure(s) or inability to maintain setpoint temperatures and humidity levels. Should the contractor elect to utilize the building's permanent HVAC system, the contractor shall bring the HVAC systems and ductwork back to an original unused condition or state by thoroughly cleaning and/or repairing

both equipment and ductwork including repair and refinishing scrapes, tears, scratches and dents, cleaning ductwork, cleaning AHU coils, etc.

- L. All dust, dirt, fungal growth, and debris in duct work shall be cleaned.
- M. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.
- N. Contractor's Use of Permanent HVAC Systems:
  - 1. Heating System:
    - a. Should the contractor (at his option and at his own risk), utilize the building's permanent heating systems provided under this contract to provide space heating prior to project completion date subject to the restraints stated herein.
    - b. The fuel for such space heating and for required tests of heating equipment shall be provided by contractor.
    - c. The start up of equipment for use by the contractor shall not commence any warranty period.
    - d. The heating system shall be operated only by qualified personnel, and shall be operated with all auxiliaries, safeties, and in accordance with manufacturer's instructions and good operating practice.
    - e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, contractor will be directed to disconnect its use.
    - f. Heating systems shall be operated and controlled to prevent temperature in any room or space in any building from exceeding 90 deg. F.
    - g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork piping, etc., shall not either fall or be elevated above or below normal operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.
    - h. Systems shall not be operated unattended such as on holidays, weekends, nights, etc, nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to "monitor or attend to" the systems such as security personnel, or janitorial staff. The heating system, when in operation, shall be continuously monitored by the mechanical contractor's approved personnel.
    - i. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air ductwork from accumulating dust or otherwise becoming dirty.
    - j. Prior to final acceptance of the work, the contractor shall place heating systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.
    - k. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.
  - 2. Preliminary Heating Test, Adjusting and Balancing Report:
    - a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:
      - 1) Air pressure drop across the unit filters
      - 2) Air pressure drop across the unit's cooling coil(s)
      - 3) Air pressure drop across the unit's heating coil(s)

- 4) Total static pressure produced by the unit
  - 5) Discharge air static pressure
  - 6) Fan RPM
  - 7) Suction air pressure
  - 8) Provide a unit pressure graph
  - 9) Discharge air temperature (each air moving device)
  - 10) Return air temperature (each air moving device)
  - 11) Entering water temperatures (hot & chilled)
  - 12) Leaving water temperatures (hot & chilled)
  - 13) Water flow quantity (gpm) through the coil(s)(hot & chilled)
3. Air Conditioning System:
- a. Should the contractor (at his option and at his own risk), utilize the building's permanent air conditioning systems provided under this contract to provide space cooling and de-humidification prior to the project completion date. As such, any damages, loss of performance, wear, and other detrimental effects caused by the operational performance characteristics of the A/C system such as condensation, sweating of grilles, registers, diffusers, ducts, equipment, walls, floors, ceilings, and other conditions which may cause damage to building components or which cause mold, mildew, etc., shall be the total responsibility of the contractor.
  - b. The fuel, electricity or other energy required for space cooling and for any subsequent operation or testing shall be provided by the Contractor.
  - c. The cooling system(s) shall be operated only by fully qualified personnel and shall be operated with all safety auxiliaries, and in accordance with manufacturer's instructions and good operating practice.
  - d. Start-up of equipment for use by the Contractor shall not commence any warranty period.
  - e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, the contractor will be directed to discontinue and disconnect its use and the contractor will be required to provide portable units to maintain space temperatures.
  - f. Temporary cooling and/or de-humidification systems shall be operated and controlled to prevent temperature and humidity in any room or space in any portion of the building from falling below 75 deg. F or above 65% relative humidity.
  - g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork, piping, etc., shall not fall below the normal stated "design" operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.
  - h. Insulation systems for all piping, ductwork, etc., shall be completely installed prior to use of the permanent systems.
  - i. Systems shall not be operated unattended such as on holidays, weekends, nights, etc., nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to "monitor or attend to" the systems such as security personnel, or janitorial staff. The air conditioning system when in operation, shall be continuously monitored by the mechanical contractor's approved personnel.
  - j. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air duct work from accumulating dust or otherwise becoming dirty.

- k. Contractor shall, prior to final acceptance of the work, place cooling systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.
- l. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.
- 4. Preliminary Air Conditioning Test, Adjusting and Balancing Report:
  - a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:
    - 1) Air pressure drop across the unit filters
    - 2) Air pressure drop across the unit's cooling coil(s)
    - 3) Air pressure drop across the unit's heating coil(s)
    - 4) Total static pressure produced by the unit
    - 5) Discharge air static pressure
    - 6) Fan RPM
    - 7) Suction air pressure
    - 8) Provide a unit pressure graph
    - 9) Discharge air temperature (each air moving device)
    - 10) Return air temperature (each air moving device)
    - 11) Entering water temperatures (hot & chilled)
    - 12) Leaving water temperatures (hot & chilled)
    - 13) Water flow quantity (gpm) through the coil(s)(hot & chilled)

END OF SECTION 23 00 00

## SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.
  4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

#### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  1. For motors with 2:1 speed ratio, consequent pole, single winding.
  2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
  1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

#### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

#### 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  1. Permanent-split capacitor.
  2. Split phase.
  3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. All materials and equipment shall be installed in accordance with Manufacturer's recommended installation methods for obtaining conformance with the Contract Documents.
- B. Alignment of all motors, factory coupled or mounted, and all motors field coupled and mounted, shall be rechecked after all connections have been made and after 48 hours of operation in designed service.
- C. Verify the voltage characteristics of each motor prior to ordering.
- D. Verify the correct wire connections and rotation of equipment by "bumping" motor after wiring.
- E. Confirm voltage imbalance on 3-phase motors is less than 2%.

### 3.2 APPLICATION: Except as specifically indicated, motors shall be selected as follows:

- A. Phase:
  - 1. Less than 1.0 HP: Single-Phase.
  - 2. 1 HP and Larger: Three-phase.
- B. Single Phase Starting:
  - 1. 1/8 HP and Less: Split phase or permanent split capacitor.
  - 2. Greater than 1/8 HP: Capacitor start.
- C. Enclosure:
  - 1. Totally enclosed fan-cooled (TEFC) for all motors located outside above roof, in wet areas, in mechanical rooms, or elsewhere as indicated.
  - 2. Open drip-proof (ODP) for motors located elsewhere, in a clean, dry environment.

END OF SECTION 23 05 13

## SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Metal pipe hangers and supports.
  2. Trapeze pipe hangers.
  3. Metal framing systems.
  4. Thermal-hanger shield inserts.
  5. Fastener systems.
  6. Pipe stands.
  7. Equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1.
  - 2. Manufacturers:
    - a. Cooper B-Line, Inc.; a division of Cooper Industries.
    - b. Flex-Strut Inc.
    - c. Thomas & Betts Corporation, A Member of the ABB Group.
    - d. Unistrut; an Atkore International company.
    - e. Wesanco, Inc.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturred lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  - 7. Metallic Coating: Electroplated zinc.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use thermal-hanger shield inserts for insulated piping and tubing.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 23 05 29

## SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment Labels.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Manufacturer shall be one of the following:
    - a. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Carlton Industries, LP.
    - d. Champion America.
    - e. Craftmark Pipe Markers.
    - f. Emedco.
    - g. Kolbi Pipe Marker Co.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Seton Identification Products.
  - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 3. Letter Color: White.
  - 4. Background Color: Black.
  - 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  8. Fasteners: Stainless-steel rivets.
  9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules).
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulated.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

END OF SECTION 23 05 53

## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SCOPE OF WORK

- A. The Contractor shall obtain the services of an independent Test and Balance (TAB) Company which specializes in the testing and balancing of heating, ventilating and air conditioning (HVAC) systems to test, adjust and balance all HVAC systems in the building(s).
- B. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. The testing, adjusting and balancing agency shall act as a reporting agency; that is, list and report each piece of equipment as to identification number, manufacturer, model number, serial number, proper location, specified performance, and report actual performance of all equipment as found during testing. The report is intended to be used during the life of the building as a ready reference indicating original conditions, equipment components, etc.
- C. Representatives of the Test and Balance Company shall visit the job site during installation of the HVAC equipment, piping and ductwork as required.
- D. Upon completion of the HVAC system installation, the Test and Balance Company shall perform all required testing and balancing with the full cooperation of the Contractor and his Sub-contractors. The Contractor shall make changes and/or adjustments to the HVAC system components that are required by the Test and Balance Company to accomplish proper balancing. The TAB agency shall not supply or install any materials or balancing devices such as pulleys, drives, belts, etc. All of this work is by the Contractor and shall be performed at no additional cost to the Owner.
- E. The test and balance report complete with a summary page listing all deficiencies shall be submitted to the Architect for review. If the Architect agrees with the report, he shall sign it and return it to the Contractor. The test and balance report must be complete and must be accepted by the Architect prior to acceptance of the project. Any outstanding test and balance items shall be placed on the punch list and a monetary value shall be assigned to them.
- F. After all deficiencies have been corrected the Architect shall sign the testing and balancing report, and the Test and Balance Company shall supply four (4) copies of the final and complete report to the Contractor for inclusion in the Operation and Maintenance Manuals.

- G. The Test and Balance Company shall obtain a copy of all HVAC related shop drawings from the contractor. The contractor shall provide a set of approved shop drawings to the TAB contractor within 30 days from receiving approved shop drawings.
- H. The items requiring testing, adjusting, and balancing include (but are not restricted to) the following:
  - 1. Air Systems:
    - a.
    - b. Supply Fan AHU
    - c. Supply Fan ERV
    - d. Relief Fans
    - e. Exhaust Fans
    - f. Zone Branch and main ducts
    - g. VAV Systems
    - h. Diffusers, Registers, Grilles and Dampers
    - i. Coils (Air Temperatures)
    - j. Valves
    - k. Vibration Isolators
  - 2.
  - 3. Duct leakage tests.

### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.
- B. Sample report forms.

### 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine operating safety interlocks and controls on HVAC equipment.

- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors.
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified.

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.
  7. Record final fan-performance data.

### 3.6 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.

### 3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.

- C. Record fan and motor operating data.

### 3.8 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.
- D. Ductwork that initially fails these tests shall be replaced, modified, resealed, etc. as required to meet the leakage requirement and then re-test to ensure compliance.

### 3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Equipment with Fans: Plus or minus 10 percent.
  - 2. Exhaust Fans: Plus 10 percent.
  - 3. Outside Airflow: Plus 10 percent.
  - 4. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.

8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Fan drive settings including settings and percentage of maximum pitch diameter.
  - e. Settings for supply-air, static-pressure controller.
  - f. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
  - a. Unit identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Unit arrangement and class.
  - g. Discharge arrangement.
  - h. Sheave make, size in inches, and bore.
  - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - j. Number, make, and size of belts.
  - k. Number, type, and size of filters.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Filter static-pressure differential in inches wg.
  - f. Preheat-coil static-pressure differential in inches wg.
  - g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. Outdoor airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outdoor-air damper position.
  - l. Return-air damper position.

- m. Vortex damper position.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- G. Instrument Calibration Reports:
- 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.
- B. Architect may randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, the design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### 3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13 – DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following duct services:
  1. Indoor, concealed supply air.
  2. Indoor, concealed return air.
  3. Indoor, concealed exhaust air.
  4. Indoor, concealed outdoor air.
  5. Indoor, return air plenum boxes.
  6. Indoor, tops of ceiling diffusers and grilles.
  7. Mechanical Room Walls

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  3. Detail application of field-applied jackets.
  4. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields as specified.
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Fire Rated Insulation:
  - 1. Manufacturer shall be one of the following:
    - a. 3M FireMaster Fast Wrap 615+.
    - b. Thermal Ceramics FireMaster.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Manufacturer shall be one of the following:
    - a. Aeroflex, USA, Inc.
    - b. Armacell LLC.
- H. Fiber-Glass Blanket Insulation: Fiber-Glass bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturer shall be one of the following:
    - a. Certainteed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Manufacturer shall be one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand.
- C. Fiber-Glass Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturer shall be one of the following:
    - a. Childers Brand.
    - b. Eagle Bridges – Marathon Industries.
    - c. Foster Brand.
    - d. Mon-Eco Industries, Inc.

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturer:
    - a. Foster Brand.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
    - d. Childers.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.

## 2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
  5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.7 SECUREMENTS

### A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - d. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - e. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - f. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

### C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

## 2.8 WALL LINER

### A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers shall be as follows:
  - a. Certainteed
  - b. Owens Corning
  - c. Johns Manville
  - d. Knauf
2. Maximum Thermal Conductivity:
3.
  - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

- 5.
  6. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.

- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies.

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF FIBER-GLASS INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

- c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 WALL LINER

- A. Apply on all mechanical room walls from floor to ceiling / deck.
  1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners or cut and fit to ensure butted-edge overlapping.
  5. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

### 3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.12 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.
2. Indoor, concealed return air.
3. Indoor, concealed exhaust air.
4. Indoor, concealed outdoor air.
5. Indoor, return air plenum boxes.
6. Indoor, tops of ceiling diffusers and grilles.
7. Mechanical Room Walls

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

### 3.13 DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

E. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

F. Concealed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

H. Concealed, rectangular, exhaust-air duct shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

- I. Concealed, supply-air plenum insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  - 2. Minimum installed R-value shall be R-6.0.
  
- J. Return air plenum boxes installation shall be the following:
  - 1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  - 2. Minimum installed R-value shall be R-6.0.
  
- K. Tops of supply air diffusers and grilles insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  - 2. Minimum installed R-value shall be R-6.0.
  - 3.
  
- L. Mechanical Room Wall Liner (Thickness):
  - 1. Wall Liner: Fibrous glass, Type I, 1 inch thick.

END OF SECTION 23 07 13

## SECTION 23 07 19 - HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
  1. Condensate drain piping, indoors and outdoors.
  2. Refrigerant suction and hot-gas piping, indoors and outdoors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Manufacturer shall be one of the following:
    - a. Armacell AP.
    - b. Aeroflex USA.
    - c. K-Flex USA.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
  - 1. Manufacturers shall be one of the following:
    - a. Childers Brand.
    - b. Eagle Bridges – Marathon Industries.
    - c. Foster Brand.
  - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  - 5. Color: White.

## 2.4 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Finish and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - c. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies.

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.

### 3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inches thick.

### 3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material.

- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Refrigerant Piping, Concealed:
  - 1. None.
- D. Refrigerant Piping, Exposed:
  - 1. Aluminum, Smooth: 0.016 inch thick.

3.12 OUTDOOR, FIELD-APPLIED MASTIC SCHEDULE

- A. Install two layers of mastic **over** insulation material.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Condensate and refrigerant Piping, Concealed:
  - 1. None.
- D. Condensate and Refrigerant Piping, Exposed:
  - 1. Vapor-Barrier Mastic: Solvent based.

END OF SECTION 23 07 19

## SECTION 23 21 14 – HVAC CONDENSATE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
  - 1. Condensate-drain piping.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Copper Tube.
  - 2. Plastic pipe and fittings with solvent cement.
- B. Delegated-Design Submittal:
  - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  - 1. Condensate-Drain Piping: 140 deg F.

## 2.2 COPPER TUBE AND FITTINGS

- A. DWV Copper Tubing: ASTM B 306, Type DWV.

## 2.3 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
  - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

## 2.4 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- D. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. PVC solvent cement shall have a VOC content of 510 g/L or less.
    - b. Adhesive primer shall have a VOC content of 550 g/L or less.
    - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
  - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
  - 1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- B. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

### 3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- M. Install shutoff valve immediately upstream of each dielectric fitting.

- N. Comply with requirements specified for identifying piping.

### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

### 3.4 HANGERS AND SUPPORTS

- A. Comply with requirements specified for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- D. Plastic Piping Hanger Spacing: Space hangers shall be according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
- F. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

END OF SECTION 23 21 14

## SECTION 23 23 00 - REFRIGERANT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Refrigerant pipes and fittings.
  2. Refrigerant piping valves and specialties.
  3. Refrigerants.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant pipe and refrigerant piping specialty.
- B. Shop Drawings:
  1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; pipe lengths, branch controller locations, valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
  2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  3. Show interface and spatial relationships between piping and equipment.
  4. Calculate refrigerant volume based on actual pipe layout for each VRF system.
  5. Shop Drawing Scale: 1/8 inch equals 1 foot.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants."

- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

## 1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-454B/R-32:
  1. Suction Lines for Air-Conditioning Applications: 300 psig.
  2. Suction Lines for Heat-Pump Applications: 535 psig.
  3. Hot-Gas and Liquid Lines: 535 psig.

### 2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or ASTM B 280, Type ACR.
- B. Contractor may use pre-insulated refrigerant line sets provided and/or approved by the VRF equipment manufacturer.

### 2.3 REFRIGERANTS

- A. ASHRAE 34, R-454B or R-32

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS FOR REFRIGERANT R-454B/R-32

- A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR Type L, annealed- or drawn-temper tubing and copper fittings with brazed joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with soldered joints.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- M. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

### 3.4 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified.
- B. Install the following pipe attachments:
  1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
  1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
  2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
  3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
  4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
  5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
  8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
  9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Comply with ASME B31.5, Chapter VI.
  2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
  4. For VRF Systems: Test all refrigerant systems with pressure and vacuum per manufacturers recommendations. Refrigerant lines shall be tested under 600 (Minimum) psi Nitrogen pressure (or as recommended by manufacture for refrigerant type being used in each system) for 24 hours using soap suds at joints to test for leaks. Contractor shall perform a vacuum test (triple pull down test) at 1500 Microns with nitrogen break, then 1000 microns with nitrogen break, then 500 microns – disconnect vacuum pump and hold

vacuum for one (1) hour (Maximum of 100-point rise within the one-hour time period). If any test fails, the contractor shall repair leak(s) and completely retest the piping systems(s) (Pressure and vacuum tests). Once all tests are passed, evacuate the system, and properly charge with Refrigerant.

- B. Prepare test and inspection reports.

### 3.6 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

END OF SECTION 23 23 00

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Adhesives.
  - 2. Sealants and gaskets.

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6,

"Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Duct Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Galvanized sheet metal for rectangular and round ductwork shall have a minimum gauge of 26.

## 2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers shall be as follows:
    - a. Certaineed
    - b. Owens Corning
    - c. Johns Manville
    - d. Knauf
  - 2. Maximum Thermal Conductivity:
  - 3.
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements as specified for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

### 3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article."
- B. If ducts are not listed in the "Duct Schedule" Article then seal unlisted ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Ducts:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than **3-Inch wg**:
      - 1) Test representative duct sections totaling no less than **25 percent** of total installed duct area for each designated pressure class.
    - b. Exhaust Ducts with a Pressure Class of **2-Inch wg or Higher**:
      - 1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.
    - c. Outdoor Air Ducts with a Pressure Class of **2-Inch wg or Higher**:
      - 1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.7 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.8 START UP

- A. Air Balance: Comply with requirements as specified.

### 3.9 DUCT SCHEDULE

#### A. Supply Ducts:

1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units and RTUs:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.

#### B. Return Ducts:

1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units and RTUs:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.

#### C. Return Ducts:

1. Ducts Connected to Variable-Volume Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.

#### D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
  - a. Pressure Class: Negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
  - c. SMACNA Leakage Class for Rectangular: 12.
  - d. SMACNA Leakage Class for Round and Flat Oval: 6.

#### E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 6.
  - d. SMACNA Leakage Class for Round and Flat Oval: 3.

#### F. Duct Liner (Thickness):

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

3. Supply Diffuser Plenums: Fibrous glass, Type I, 1 inch thick.
4. Return Plenums: Fibrous glass, Type I, 1 inch thick.
5. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

END OF SECTION 23 31 13

## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Manual volume dampers.
  2. Motorized dampers.
  3. Spin Collars.
  4. Fire dampers.
  5. Ceiling Radiation Dampers.
  6. Turning vanes.
  7. Duct-mounted access doors.
  8. Duct Access Panel Assemblies.
  9. Flexible connectors.
  10. Flexible ducts.
  11. Duct accessory hardware.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
  2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 MANUAL VOLUME DAMPERS

- A. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers:
    - a. Greenheck.
    - b. Dace Mfg.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Ruskin Company.
  2. Comply with AMCA 500-D testing for damper rating.
  3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  4. Suitable for horizontal or vertical applications.
  5. Frames:
    - a. Hat Channel shaped.
    - b. 0.031-inch- thick, galvanized sheet steel.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  6. Blades:
    - a. Multiple blade.
    - b. Opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, roll-formed steel, 0.031 inch thick.
  7. Blade Axles: Galvanized steel.
  8. Bearings:
    - a. Molded synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  9. Blade Seals: Neoprene.
  10. Jamb Seals: Stainless Steel.
  11. Tie Bars and Brackets: Galvanized steel.
  12. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Jackshaft:
1. Size: 0.5-inch diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

- C. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

## 2.4 MOTORIZED DAMPERS

- A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- B. Manufacturers:
  - 1. Greenheck.
  - 2. Flex-Tek Group.
  - 3. Nailor Industries Inc.
  - 4. Pottorff.
  - 5. Ruskin Company.
- C. For Round Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CDRS25, Greenheck Model VCDR-53, Arrow Series 250SRD or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.
- D. For Rectangular Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CD36/PB, Arrow Series 1770, Greenheck Model VCD-23 or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.
- E. Frames:
  - 1. Hat shaped.
  - 2. 0.064-inch- thick, galvanized sheet steel.
  - 3. Mitered and welded corners.
- F. Blades:
  - 1. Multiple blade with maximum blade width of 6 inches.
  - 2. Opposed-blade design.
  - 3. Galvanized-steel.
  - 4. 0.064 inch thick single skin.
  - 5. Blade Edging: Closed-cell neoprene.
  - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- G. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
  - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.

- H. Bearings:
1. Molded synthetic.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.

## 2.5 SPIN COLLARS

- A. All round take-offs to round branch duct shall be made with factory fabricated spin-type collar fittings with balancing damper and constructed of minimum 26 ga galvanized steel. The damper shall have a raised 2" handle with a high quality locking quadrant. A 3/8" continuous rod with "U" bolts connects the damper to the rod. Nylon end bearing are required where the rod penetrates the spin collar barrel. These spin-collars shall be as manufactured by Flexmaster Model FLD-B03, Dace #26ga MSD-C03 or approved equal.

## 2.6 FIRE DAMPERS

- A. The contractor shall furnish and install UL555 rated 1-1/2 hour fire dampers at the locations indicated on the drawings in new ducts and sound attenuators. The contractor shall provide dampers with sleeves and angle frames necessary to comply with the manufacturer's UL installation requirements. Dampers for vertical or horizontal air flow shall be provided as required.
- B. Manufacturers:
1. Greenheck.
  2. Flex-Tek Group.
  3. Nailor Industries Inc.
  4. Pottorff.
  5. Ruskin Company.
- C. Fire damper shall be 100% free area and installed in wall and floor openings utilizing steel sleeves, angles, other materials and practice required to provide an installation equivalent to that utilized by the manufacturer when dampers are tested by UL555. Installation shall be in accordance with the damper manufacturer's instructions.
- D. Fire damper for rectangular ductwork and transfer openings shall be Ruskin type DIBD-B, Greenheck Model DFD-150-B (Basis of Design).
- E. Fire dampers for round ductwork shall be Ruskin Model DIBD-CR, Greenheck DFD-150-CR (Basis of Design).
- F. All fire dampers shall be installed per N.F.P.A. and U.L. requirements. Install U.L. approved sealant around the perimeter of the angle iron support at the sleeve and the wall in accordance with U. L. recommendations.
- G. All fire dampers shall meet the latest Class 1 leakage requirements.

## 2.7 CEILING RADIATION DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Nailor Industries Inc.
  - 2. Pottorff.
  - 3. Ruskin Company.
- B. General Requirements:
  - 1. Labeled according to UL 555C by an NRTL.
  - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- F. Fire Rating: 1 hours.

## 2.8 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.9 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
  - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
  - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
  - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
  - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.10 DUCT ACCESS PANEL ASSEMBLIES

- A. Labeled according to UL 1978 by an NRTL.
- B. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- C. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- E. Minimum Pressure Rating: 10-inch wg, positive or negative.

## 2.11 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  1. Minimum Weight: 26 oz./sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  1. Minimum Weight: 24 oz./sq. yd..
  2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  3. Service Temperature: Minus 50 to plus 250 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.12 FLEXIBLE DUCTS

- A. Manufacturers:
  1. Thermaflex Model M-KE
  2. Flexmaster 1M
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-value: Comply with ASHRAE/IESNA 90.1. (R6)
- C. Flexible Duct Connectors:
  1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
  2. Non-Clamp Connectors: Liquid adhesive plus tape.

## 2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Upstream from duct filters.
  - 2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 4. At each change in direction and at maximum 50-foot spacing.
  - 5. Control devices requiring inspection.
  - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.

- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

## SECTION 23 34 23 - HVAC POWER VENTILATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. High Volume Low Speed Circulating Fans.
  2. Centrifugal Ceiling Fans.
  3. Wall propeller fans.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Operating Limits: Classify according to AMCA 99.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  1. Certified fan performance curves with system operating conditions indicated.
  2. Certified fan sound-power ratings.
  3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  4. Material thickness and finishes, including color charts.
  5. Dampers, including housings, linkages, and operators.
  6. Roof curbs.
  7. Fan speed controllers.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

## 1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 CEILING MOUNTED FANS

- A. Manufacturers:
  - 1. Cook.
  - 2. Greenheck.
  - 3. ACME
  - 4. Pen-Barry
  - 5. Twin City
- B. All exhaust fans shall be equipped with bird screen, automatic back-draft dampers, solid state speed controller (direct drive) and integral disconnect switch unless noted otherwise. Fan motors shall be of the 40 deg C ambient temperature rise type and shall be suitable for continuous duty operation.
- C. Direct drive fans shall be complete with solid state speed control switch mounted on unit for balancing. Interlock with remote on/off switch.
- D. Housing: Steel, lined with acoustical insulation.
- E. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- F. Grille: White ceiling mounted metal grille. The grille shall be removable to provide service access to fan, motor, etc.
- G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

### 2.2 HIGH VOLUME LOW SPEED CIRCULATING FANS

- A. Manufacturers:
  - 1. Big Ass Fans Solutions.
  - 2. Macro-Air.
  - 3. Greenheck
  - 4. EPIC

- B. The fan shall be the models scheduled with the capacities indicated. The fan shall be furnished with mounting hardware and variable speed controls.
- C. Installation of the fan shall include miscellaneous or structural metal supports, field electrical wiring, cable, conduit, fuses, disconnect switches, etc.
- D. The fan shall be designed to move an effective amount of air for cooling and destratification in small, low ceiling commercial applications. The fan, in operation, shall not disturb other hanging objects within 2' of its circumference to a distance of 3' below its airfoils. The fan shall incorporate a direct drive system designed specifically for high volume, low speed fans to ensure silent operation. The sound levels from the fan operating at maximum speed shall not exceed 40 dBA (measured 20' below the blades and 20' horizontally from the center of the fan).
- E. The fan shall be equipped with high volume, low speed airfoils of precision extruded aluminum alloy. Each airfoil shall be of the high performance design. The airfoils shall be connected by means of two (2) sets of bolts and lock washers per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.
- F. The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100-130 VAC, single phase, without requiring adapters or customer selection. The motor shall be a non-ventilated, heat sink design with the capability of continuous operation in -40oF to 104oF ambient conditions.
- G. The fan hub shall be constructed of steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly. The hub shall incorporate five (5) safety retaining clips made of 1/8" thick steel that shall restrain the hub/airfoil assembly in case of shaft failure.
- H. The fan mounting system shall be designed for quick and secure installation from a structural support
- I. All components in the mounting system shall be of welded construction using low carbon steel no less than 3/16" thick and powder coated for corrosion resistance and appearance. All mounting bolts shall be SAE Grade 8 or equivalent and rated with a minimum tensile strength of 150,000 psi.
- J. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 1/4" diameter and fabricated out of 7 x 19 stranded galvanized steel. The loops shall be secured with swaged Nicopress fittings, pre-loaded and tested to 3,000 lb-f.
- K. Field construction of safety cables is not permitted.
- L. The fan controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and braking torques. The controller shall be equipped with a simple diagnostic program and an LED light to identify and relay faults in the system. The controller shall be housed in an enclosure independent of the motor to prevent overheating or electrical interference.

- M. The fan shall be equipped with a remote wall control. The wall control shall be capable of mounting to a standard receptacle by means of a mounting plate (which shall be included with the wall mounted device) and shall include operator controls and display for controlling the fan's power and speed. Communication with the fan drive and controller shall be by a standard, line voltage cable that is field installed and provided by the installer.
- N. The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including transportation charges) pursuant to the complete terms and conditions of the Warranty in accordance to the following schedule: Airfoils and Hub - Lifetime (Parts), Motor and Controller - 3 years (Parts), Labor - 1 year (Commercial and Industrial Install Only).
- O. The fan shall be mounted to an angle iron or I-beam structure. Consult the manufacturer's Installation Guide for proper sizing and placement of angle iron for a span mount. A structural engineer shall be consulted for installation methods outside the manufacturer's recommendation and a certification submitted prior to installation.
- P. To reduce the risk of injury to persons, the fan shall be installed so that the airfoils are at least 10' above the floor. The fan installation area must be free of obstructions such as lights, cables, sprinklers or other building structures; with the airfoils at least 2' clear of all obstructions. The fan should not be installed where it will be continuously subjected to wind gusts or in close proximity to the outputs of HVAC systems.
- Q. If the fan is hung from an extension tube that measures 4' or longer, it may be necessary to provide guy cables or struts to limit potential lateral movement of the fan. A stiffening strut braced against an additional beam may be required if there is a close clearance situation.
- R. The design criteria for the fan mounting system shall be capable of handling 300 ft-lbs of torque.
- S. Provide fan with a fire alarm interlock relay. Interlock fan with the fire alarm system to stop the operation of the fan when the fire protection sprinkler system is activated.

### 2.3 WALL PROPELLER FANS

- A. Manufacturers:
  - 1. Cook.
  - 2. Greenheck.
  - 3. ACME
  - 4. Pen-Barry
  - 5. Twin City
- B. Installation of the fan shall include miscellaneous or structural metal supports, field electrical wiring, cable, conduit, fuses, disconnect switches, etc.
- C. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- D. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

- E. Fan Wheel: Replaceable, aluminum, airfoil blades fastened to steel hub; factory set pitch angle of blades.
- F. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- G. Fan Drive:
  - 1. Resiliently mounted to housing.
  - 2. Statically and dynamically balanced.
  - 3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
  - 4. Extend grease fitting to accessible location outside of unit.
  - 5. Service Factor Based on Fan Motor Size: 1.4.
  - 6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
    - a. Ball-Bearing Rating Life: ABMA 9,  $L_{10}$  of 100,000 hours.
  - 8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
  - 9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - 10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  - 11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- H. Accessories:
  - 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
  - 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
  - 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
  - 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
  - 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
  - 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
- I. Capacities and Characteristics: See Mechanical Schedules.
- J. Spark Arrestance Class: [A] [B] [C].

## 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

## 2.5 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified.

### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment.

### 3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION 23 34 23

## SECTION 23 37 13 - DIFFUSERS, REGISTERS, GRILLES, AND LOUVERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Rectangular and square ceiling diffusers.
- 2. Louvered face diffuser.
- 3. Fixed face registers and grilles.
- 4. Louvers.

- B. Related Sections:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
- 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:

- 1. Manufacturers:
  - a. Titus.
  - b. Price Industries.
  - c. Nailor Industries.
  - d. Metalaire, Inc.
- 2. Devices shall be specifically designed for variable-air-volume flows.
- 3. Material: Aluminum.
- 4. Finish: Baked enamel, white.
- 5. Face Size: 24 by 24 inches.
- 6. Face Style: Three cone.
- 7. Mounting: T-bar.
- 8. Pattern: Fixed.

9.

- B. Louver Face Diffuser:
  - 1. Material: Aluminum.
  - 2. Finish: Baked enamel, white.
  - 3. Face Size: See schedule on Drawings..
  - 4. Mounting: Surface with beveled frame.
  - 5. Pattern: Four-way core style.
  - 6. Dampers: Radial opposed blade.
  - 7. Accessories:
    - a. Square to round neck adaptor.

## 2.2 REGISTERS AND GRILLES

- A. Fixed Face Register:
  - 1. Manufacturers:
    - a. Titus.
    - b. Price Industries.
    - c. Nailor Industries.
    - d. Metalaire, Inc.
  - 2. Material: Aluminum.
  - 3. Finish: Baked enamel, white.
  - 4. Core Construction: Integral.
  - 5. Frame: 1 inch wide.
  - 6. Mounting: Lay in.

## 2.3 LOUVERS

- A. Provide louvers as scheduled in Drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,

locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

## SECTION 23 70 30 - AIR PURIFICATION SYSTEM

### PART 1 – GENERAL

#### 1.01 DESCRIPTION OF WORK

- A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

#### 1.02 REFERENCED CODES & STANDARDS

- A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867 including ozone chamber test

#### 1.03 RELATED WORK

- A. Testing, Adjusting and Balancing
- B. Facility Access and Protection
- C. Ductwork
- D. Filters
- E. Electrical Wiring
- F. Control Wiring

#### 1.04 QUALITY ASSURANCE

- A. The Air Purification System shall be a product of an established manufacturer in the USA and shall be manufactured and assembled in the USA.
- B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
- D. Projects designed using ASHRAE Standard 62.1 IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled. The manufacturer shall provide independent test data on a previous installation in a similar application that proves compliance to ASHRAE 62.1 and the accuracy of the calculations.

- E. The Air Purification Technology shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. All manufacturers shall submit their independent UL 867 test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.
- F. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.001 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.0012 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

#### 1.05 SUBMITTALS

- A. Submit manufacturer's technical product data for ion generators including:
  - 1. Schedule of plasma generators indicating model number and quantity of each type required for each unit/application.
  - 2. Submittal sheet for each type of plasma generator and accessories furnished; indicating construction, dimensions, electrical data, and mounting details.
  - 3. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with reduced outside air).
  - 4. Product drawings detailing all physical, electrical and control requirements.
  - 5. Copy of UL 867 independent ozone test.
- B. Operating & Maintenance Data: Submit O&M data and recommended spare parts list.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of products shall be in factory fabricated shipping cartons. Identify on outside of carton the type of product contained within. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

#### 1.07 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

### PART 2 – PRODUCTS

#### 2.01 GENERAL

- A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be manufactured by Plasma Air International ([www.plasma-air.com](http://www.plasma-air.com)). Equal by GPS Air ([www.gpsair.com](http://www.gpsair.com)) shall also be acceptable.

- B. All other suppliers of comparable products requesting prior approval shall:
1. Submit a request for prior approval at least 15 days prior to bid date. Request received after that time will not be considered.
  2. In addition, as part of the prior approval request, Bipolar Ionization manufacturers must submit their IAQ calculations that prove conformance to ASHRAE Standard 62.1-2007 with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.
  3. Submit independent test data from ETL or UL on the ozone chamber test.
  4. Submit pathogen testing per section 2.2.
  5. Submit at least two other end user references in the same application with contact phone number, email, equipment used and application for the equipment at that facility. Manufacturers not having the above references in similar applications using the same equipment models as proposed on the current project shall not be acceptable.

## 2.02 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA

- A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.
- B. The Bi-polar Ionization system shall be capable of:
1. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
  2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
  3. Reducing space static charges.
  4. Reducing space particle counts.
  5. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth.
  6. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:
    1. MRSA: 99.5% in 60 minutes or less
    2. E. Coli: 89.0% in 60 minutes or less
    3. H1N1: 86.6% in 60 minutes or less
    4. Aspergillus: 74.8% in 60 minutes or less

Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELEC accredited independent lab confirming kill rates and time meeting the minimum requirements stated in section 2.2 B, points 6a, 6b and 6c.
- C. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
  2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions to the air purification system.
- E. Ionization Equipment Requirements:
1. Electrode Specifications (Bi-polar Ionization):
    - a. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
    - b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
    - c. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.
    - d. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air stream will not be accepted.
  2. Air Handler mounted units
    - a. Ion generators for air handling unit coils shall be Plasma Air's BAR product furnished in a linear or bar mounted configuration so as to minimize the space required for installation. Ionization "BAR" shall be no more than 3" deep in the direction of airflow.
    - b. The mechanical contractor shall mount the plasma ionization bar and wire it to the remote mount power supply panel using only low voltage wiring. Low voltage wiring shall be defined as 12V. The use of high voltage cabling (600V or higher) shall not be acceptable due to safety concerns.
    - c. The remote mount power supply panel shall be capable of directly accepting voltage of 12V DC or 24V AC. The panel shall have an on/off switch, ionizer indicator LED, and a set of dry contacts which will indicate ionizer functionality. Dry contacts that indicate power available only shall not be acceptable.
    - d. For systems without dry contacts, provide a duct mounted ion sensor powered from 12V DC or 24V AC. Ion sensor to be user adjustable from 500 to 20,000 ions per cm<sup>3</sup>.
  3. Certifications
    - a. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners.
    - b. The operation of the electrodes or bipolar ionization units shall conform to UL 867 with respect to ozone generation.

F. Electrical Requirements:

1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the fan coil unit or air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
2. Wiring, conduit and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

G. Control Requirements:

1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
2. All plasma ion generators shall include an external BMS interface to indicate ion generator status and alarm.

### PART 3 – EXECUTION

#### 3.01 GENERAL

- A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

#### 3.02 ASSEMBLY & INSTALLATION: PLASMA GENERATOR WITH BI-POLAR IONIZATION

- A. All equipment shall be assembled and installed with a high level of workmanship to the satisfaction of the owner, architect and engineer.
- B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the owner.
- C. All equipment shall be protected from damage on a daily basis throughout construction.

#### 3.03 COMMISSIONING & TRAINING

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.
- B. Provide to the owner a portable hand held ion counter with a calibrated range of 0 to 20,000 ions/cm<sup>3</sup> and an accuracy of +/- 25% within the specified range. Ion counter shall have automatic zeroing capability on 10 minute intervals.

END OF SECTION 23 70 30

## SECTION 23 81 20 – SPLIT-SYSTEM AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. LEED Submittals:
  - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: Two set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.
  - 3. Fan Belts: One set(s) for each air-handling unit fan.

## 1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier.
  2. Trane.
  3. York.
  4. Lennox.
  5. Daikin

### 2.2 AIR HANDLING UNITS (5 TONS OR LESS)

- A. Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Faced, glass-fiber duct liner.
  3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  6. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
  7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  8. Filters: 1" Permanent, cleanable.
  9. Condensate Drain Pans:
    - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      - 2) Depth: A minimum of 2 inches deep.

- b. Single-wall, stainless-steel sheet.
- c. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
- d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
  - 1) Minimum Connection Size: NPS 1.
- e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
- f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

## 2.3 CONDENSING UNITS (5 TONS OR LESS)

### A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: R-410A is acceptable before 01-01-2025; R-454B or R-32 is required beginning on 01-01-2025.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- 4. Fan: Aluminum-propeller type, directly connected to motor.
- 5. Motor: Permanently lubricated, with integral thermal-overload protection.
- 6. Low Ambient Kit: Permits operation down to 45 deg F.
- 7. Mounting Base: Polyethylene.

## 2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
  - 1. Compressor time delay.

2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection including auto setting.
- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- F. Drain Hose: For condensate.
- G. Additional Monitoring:
1. Monitor constant and variable motor loads.
  2. Monitor variable-frequency-drive operation.
  3. Monitor economizer cycle.
  4. Monitor cooling load.
  5. Monitor air distribution static pressure and ventilation air volumes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
  3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
  - 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 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.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238120

## SECTION 23 81 26 – MINI-SPLIT-SYSTEM AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes mini split-system DX air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Samples for Initial Selection: For units with factory-applied color finishes.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Mitsubishi (Basis of Design)
- B. Daikin
- C. York

### 2.2 M-SERIES OUTDOOR UNIT

- A. General: The MXZ outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
- B.
  - 1. The sum of connected capacity of all M-SERIES indoor units shall range from 80% to 100% of outdoor rated capacity.
  - 2. Outdoor unit shall have a sound rating no higher than 59 dB(A).
  - 3. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.
  - 4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
  - 5. The outdoor unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.
  - 6. The outdoor unit shall have the ability to operate with a maximum height difference of 131 feet for the MXZ-8C48NA and have a total refrigerant tubing length of 492 feet for the MXZ-8C48NA. The greatest length is not to exceed 82 feet between the outdoor unit and the M-SERIES indoor units and shall not require line size changes nor traps.
  - 7. The outdoor unit shall have rated performance for heat operation at 17°F for the MXZ-8C48NA ambient temperature without additional low ambient controls.
  - 8. The outdoor unit shall be capable of cooling operation down to 23°F outdoor ambient without additional low ambient controls.
  - 9. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- C. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

D. Fan:

1. The unit shall be furnished with two direct drive, variable speed motors.
2. The fans will be forward curved type blades for quiet operation.
3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
4. The fan motor shall be mounted for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.

E. Refrigerant

1. R454bA refrigerant shall be required for all M-Series outdoor unit systems.

F. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.
2. The coil fins will have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

G. Compressor:

1. The compressor shall be a single high performance, inverter driven, modulating capacity scroll compressor.
2. The outdoor unit compressor shall have an inverter to modulate capacity.
3. The compressor shall be equipped with an internal thermal overload.
4. The compressor shall be mounted to avoid the transmission of vibration.

H. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair, non-polar shielded cable to provide total integration of the system.

## 2.3 MSZ (Wall Mounted) INDOOR UNIT

A. General:

1. The MSZ shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The MSZ shall be used with the M-Series outdoor unit. The MSZ shall support individual control using M-NET DDC controllers.

B. Indoor Unit

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-

minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the MSZ indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system. Please refer to Part 4 of this guide specification for details on controllers and other control options.
2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control
4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
6. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

7. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

## 2.4 VERTICAL/HORIZONTAL DUCTED (MULTI POSITION AIR HANDLER)

### A. General:

1. The multi-position indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition, be tested in accordance with ANSI/ASHRAE 193 and have less than 1% air leakage at 1.0 in. WG.

### B. Unit Cabinet:

1. The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted.

### C. Fan:

1. The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a brushless motor DC motor with permanently lubricated bearings.
2. The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.WG selectable.

### D. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

### E. Coil:

1. The coils shall be performance tested at the factory.

### F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

### G. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system.
2. The unit shall have a factory built in receiver for wireless remote control
3. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install unit's level and plumb.

- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

END OF SECTION 23 81 26

## SECTION 23 90 20 – TEMPERATURE CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Electric temperature control system by the air conditioning equipment manufacturer, to be installed by the mechanical contractor.
2. Thermostats.
3. Thermostat Covers.
4. Float Switches.
5. Motorized Dampers.
6. Exhaust Fans.
7. Smoke Detectors.
8. Control Wiring.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings:

1. General Requirements.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

### PART 2 - PRODUCTS

#### 2.1 THERMOSTAT

- A. Provide fully automatic programmable (7 day) room type thermostat as indicated on Plans to cycle compressor on cooling cycle, and compressor and/or electric strips in stages on heating cycle as required to maintain space conditions. Unit shall be wired for constant or automatic fan operation and shall be electrically interlocked such that the compressor may not run nor the electric strip heaters be energized unless the evaporator fan is operating. Thermostat shall be complete with fan "Auto-On" switch and system "Auto-Heat-Off-Cool" switch. Thermostats shall be mounted to meet latest A.D.A. requirements.

## 2.2 THERMOSTAT COVER

- A. Provide heavy duty plastic, key-locked thermostat covers on all thermostats. One key shall be capable of opening all covers.

## 2.3 FLOAT SWITCH

- A. Provide float switch to emergency drain pan of each AHU. Switch shall be interlocked with AHU to de-energize the unit when the water level in the pan rises above a set level. Float switch shall meet UL 508 requirements.

## 2.4 MOTORIZED DAMPERS

- A. O.A. motorized dampers shall be interlocked with A/C units in respective mechanical rooms to open when any A/C unit is "on" and closed when all A/C units are "off". Provide all necessary relays, switches, transformers, etc. as required.
- B. Motorized dampers shall be furnished and set in place by contractor installing the ductwork.
- C. Damper actuators shall be 120/1/60 electric actuators specifically selected for damper manufacturer's requirements. Controls contractor shall furnish and install actuators. Coordinate all work with contractor installing dampers.
- D. 24 V O.A. motorized dampers shall be interlocked with their respective unit to open when the A/C unit's compressor or heating strip is energized (On), and shall close when the unit's compressor and heating strip is de-energized (Off). Provide all necessary relays, switches, transformers, etc. as required.

## 2.5 EXHAUST FAN SEQUENCE OF OPERATION

- A. EXHAUST FAN #3 & 5
  - 1. Provide "on-off" switch on wall as indicated on Plans. Provide pilot light to indicate operation of fan and a solid state speed control switch mounted in fan housing shall be used for balancing air flow.
- B. EXHAUST FAN # 1, 2 & 4
  - 1. (Restrooms) Provide interlock wiring with lights. Fan shall be on when lights are "on" and off when lights are "off". Solid state speed control switch mounted in fan housing shall be used for balancing air flow.

## 2.6 SMOKE DETECTOR

- A. The Mechanical Contractor shall furnish and install a smoke detector in the supply duct and return duct of all air handlers delivering 2000 C.F.M. or above. Interlock the smoke detector to de-energize fan on actuation of detector.

- B. Smoke detectors shall have auxiliary contacts for interlock with the fire alarm system. Coordinate installation and selection of smoke detectors. Entire installation shall meet UL requirements for interlock with building fire alarm and security system.
- C. Provide remote audible and visual alarm unit with remote reset (one per AHU with smoke detector) in accordance with latest N.F.P.A. 90A requirements.
- D. Dual-chamber, ionization smoke detectors: The combination detector head, and twist-lock base shall be UL listed compatible with a UL listed fire alarm panel.
- E. The smoke detector shall have a flashing status indication LED or visual supervision. When the detector is actuated, the flashing LED shall latch on steady and at full brilliance. The detector may be reset by activating the control panel remote reset switch.
- F. The sensitivity of the detector shall be monitored without removal of the detector head. Metering set points shall be accessible on the exterior of the detector head. Field adjustment the sensitivity shall be possible when conditions require a change.
- G. It shall be possible to perform a functional test of the detector without the need of generating smoke. The test method must simulate effects of products of combustion in the chamber to ensure testing of all detector circuits.
- H. Voltage and RF transient suppression techniques shall be employed to minimize false alarm potential. A gated alarm output shall be used for additional detector stability.
- I. Auxiliary SPDT relays and/or remote LED alarm indicators shall be installed as required.
- J. Duct mounted smoke detectors shall shut down the associated air handling unit fan motor and fire/smoke damper. This contractor shall provide all equipment and labor as required to accomplish same.
- K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.7 CONTROL WIRING

- A. All wiring required in the control systems, including electrical connections for the thermostats, firestats, smoke detectors, exhaust fans and all interlocking motor control wiring shall be furnished and installed by Mechanical Contractor.
- B. All wiring shall be in conduit and in accordance with the National Electrical Code (N.E.C.).
- C. All control wiring located outdoors shall be installed in rigid or intermediate metal conduit.
- D. All control wiring located indoors where an accessible ceiling is not available shall be installed in E.M.T. conduit.
- E. All control wiring located above accessible ceilings shall be N.E.C. approved cable. All control wiring located above accessible ceilings used as air plenums shall be N.E.C. approved "plenum cable".

- F. All conductors shall be copper. Conductors used for power circuits shall be #12 TW minimum. Conductors used for control circuits shall be #18 TW (single strand) minimum. Conductors used for sensor circuits shall be #18 TW (single strand) minimum. Control wiring for DX equipment thermostats shall be 10 conductor cables.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify compatibility with and suitability of substrates.
- B. Examine roughing-in for products to verify actual locations of connections before installation.
  - 1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
  - 2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

END OF SECTION 23 90 20

## SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Supporting devices for electrical components.
  2. Electricity-metering components.
  3. Concrete equipment bases.
  4. Touchup painting.



#### 1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### 1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

- C. Coordinate electrical service connections with buildings and grounds.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.
- F. Coordinate connecting to all equipment with equipment provider. This includes mechanical, plumbing, owner provided and contractor provided equipment. Contractor to refer to equipment installation documents prior to any rough-in.
- G. Contractor to coordinate with door hardware provider, architect and owner prior to installation of any devices associated with doors to verify door operational requirement, placement of proximity readers, motion sensors, door switches, fire alarm control, magnetic locks, hold open devices, etc..
- H. Contractor to coordinate with architectural millwork shop drawings prior to rough-in for locations of under counter lighting to be installed in and around millwork. No receptacles shall be installed in an enclosed cabinet unless noted on the drawings. Outlets for refrigerators, microwaves, etc. shall be installed in the space identified on the millwork shop drawings.
- I. Contractor shall not penetrate any stair wall assemble with conduit, boxes, cabling and the like, except for items that serve the stairwell.
- J. The contractor shall label the main service disconnecting means with the maximum available fault current shall be listed on the device to meet the requirements of NFPA 70:110.24. The labeling shall be engraved plastic. The maximum available fault current shall be obtained from the electrical utility for the secondary side of the utility transformer.

## PART 2 - PRODUCTS

### 2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have

number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.2 EQUIPMENT FOR ELECTRICITY METERING BY CONTRACTOR

- A. Meter: Contractor shall provide metering per the local utility. Contractor shall provide all necessary enclosures, meter cans, etc. per the local utility requirements including any fees associated with the service.

## 2.3 CONCRETE BASES

- A. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified

## 2.4 TOUCH-UP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

# PART 3 - EXECUTION

## 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

## 3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

### 3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
1. Wood: Fasten with wood screws.
  2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  3. New Concrete: Concrete inserts with machine screws and bolts.
  4. Existing Concrete: Expansion bolts.
  5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
  6. Steel: Welded threaded studs or spring-tension clamps on steel.
    - a. Field Welding: Comply with AWS D1.1.
  7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  8. Light Steel: Sheet-metal screws.
  9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.4 FIRESTOPPING AND FIRE RATED WALLS/CEILINGS/FLOORS

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.5 CONCRETE BASES

- A. Provide a concrete base for all floor mounted equipment. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete."

### 3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.7 REFINISHING AND TOUCH-UP PAINTING

- A. Refinish and touch up paint.
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.8 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

## SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- B. Conductor Material: Copper; stranded conductor or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
- C. Conductor Insulation Types: Type THHN-THWN.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or MC Cable is allowed for concealed lighting and receptacle branch circuits.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Fire Alarm Cabling: Plenum rated in plenum areas, exposed above accessible ceilings and in conduit when concealed in finished walls, unaccessible ceilings. Secured per NFPA 70-760.
- I. Low Voltage Cabling: Plenum rated in plenum areas, exposed above accessible ceilings and in conduit when concealed in finished walls, unaccessible ceilings. Secured per NFPA 70-760.
- J. Single Phase Circuits: Provide a dedicated neutral. Sharing of neutrals is not allowed.

### 3.2 INSTALLATION

- A. Conceal cables in conduit in finished walls, unaccessible ceilings, and floors.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Support cables according to Section "Basic Electrical Materials and Methods."
- E. Identify and color-code conductors and cables according to Section "Electrical Identification."

- F. Use #10 AWG conductors for 20 amperage 120 circuits when the circuit conductors are longer than 75 feet. Use #10 AWG conductors for 20 amperage 277 circuits when the circuit conductors are longer than 200 feet.

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
  - 1. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

END OF SECTION 26 05 19

## SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
  - 1. Underground grounding.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
  - 1. No. 4 AWG minimum, soft-drawn copper.

2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches by 24" minimum in cross section, unless otherwise indicated; with insulators.

## 2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

## 2.4 GROUND ACCESS WELLS

- A. Molded high density polyethylene well with 9" diameter twist-lock cover and locking bolt. Two knock-outs (mouse holes) for routing conductor to inside. Harger #GAW910 or equal.

# PART 3 - EXECUTION

## 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.
  2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits

D. Pad-Mounted Transformers and Switches: The following is a minimum if the utility company does not have requirements, otherwise meet the utility company requirements. Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

### 3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
  2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- F. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
  2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
  3. Install ground access well with cover for each ground rod (mounted flush with finished grade).

- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
  
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
  
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
  
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural

drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
  3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

## SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps / single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC RMC EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

## SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Refer to architectural for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 2. "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 3. "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, floor boxes, and cabinets.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70-Latest edition or edition enforced by state and local code authority.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 METAL WIREWAYS

- A. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.2 NONMETALLIC WIREWAYS

- A. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

## 2.3 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating and two coats of paint. Color by Architect.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Floor Boxes: Cast metal, fully adjustable, rectangular with four separate wiring compartments for power outlets, voice and data outlets, and/or AV devices as indicated on the drawing. Wiremold RFB4 Series, T&B 665 Series or approved equal. Covers shall be UL Listed to U.S. and Canadian safety standards for tile, carpet, wood, bare concrete and terrazzo floors. Covers shall be selected by the architect and shall be of Nickel, Brass, Black, Gray or Bronze.
- B. Poke Thru Floor Boxes: Two hour rated poke thru floor unit with capabilities of two duplex power receptacles, data and AV devices. Provide power, data and phone outlets indicated on drawing. Wiremold Evolution Series 6AT or prior approved equal. Covers shall be selected by the architect and shall be of Nickel, Brass, Black, Gray or Bronze. Poke thru floor boxes are to be utilized on upper floors unless noted otherwise. There must be accessibility in the space below the poke thru box.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.
- G. In grade enclosures, boxes and covers are required to conform to all test provisions of the most current ANSI/SCTE 77 "Specification For Underground Enclosure Integrity" for Tier 22 applications. When multiple "Tiers" are specified the boxes must physically accommodate and structurally support compatible covers while possessing the highest Tier rating. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box & cover) are manufactured using matched surface tooling. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal. Cover to be labeled per use of box, ie "Electrical, Communications, etc". Communications pull boxes shall be a minimum of 24" w x 36" l x 36" d.

## 2.5 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

## 2.6 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Aluminum Rigid Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.
- D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- E. Plastic Coated IMC and Fittings: NEMA RN 1.
- F. EMT and Fittings: ANSI C 80.3.
- G. EMT and Fittings: ANSI C80.3.
- H. FMC: Aluminum
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

#### A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 4.

#### B. Indoors:

1. Exposed: EMT in non finished areas. Surface metal raceway in existing finished unaccessible areas unless noted otherwise.
2. Concealed: EMT. MC Cable is allowed for concealed lighting and receptacle branch circuits.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations above Ground: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
  - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

- C. Minimum Raceway Size: 3/4-inch trade size (DN 21) below grade and ½ inch trade size above grade. When combining circuits, min. 3/4-inch trade size required.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

### 3.2 INSTALLATION

- A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover. Conduits larger than 1" shall not be installed in the slab.
  - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - 2. Space raceways laterally to prevent voids in concrete.
  - 3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - 1. Use insulating bushings to protect conductors.
- K. Tighten set screws of threadless fittings with suitable tools.

- L. Terminations:
  - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- N. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- O. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- P. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- Q. Set floor boxes level and flush with finished floor surface.
- R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

### 3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

## SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Identification for conductors and communication and control cable.
  - 2. Warning labels and signs.
  - 3. Instruction signs.
  - 4. Equipment identification labels.
  - 5. Miscellaneous identification products.

#### 1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.

#### 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes and standards. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

### 2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

### 2.3 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

## 2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb, minimum.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
  
- B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
  - 1. Exterior Concrete Unit Masonry:
    - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      - 1) Block Filler: Concrete unit masonry block filler.
      - 2) Finish Coats: Exterior semigloss acrylic enamel.
  - 2. Exterior Ferrous Metal:
    - a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Exterior ferrous-metal primer.
      - 2) Finish Coats: Exterior semigloss alkyd enamel.
  - 3. Exterior Zinc-Coated Metal (except Raceways):
    - 1) Primer: Exterior zinc-coated metal primer.
    - 2) Finish Coats: Exterior semigloss alkyd enamel.
  - 4. Interior Ferrous Metal:
    - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior ferrous-metal primer.
      - 2) Finish Coats: Interior semigloss acrylic enamel.
  - 5. Interior Zinc-Coated Metal (except Raceways):
    - a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      - 1) Primer: Interior zinc-coated metal primer.
      - 2) Finish Coats: Interior semigloss acrylic enamel.
  
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. **Branch-Circuit Conductor Identification:** Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- B. **Conductors to Be Extended in the Future:** Attach write-on tags to conductors and list source and circuit number.
- C. **Auxiliary Electrical Systems Conductor Identification:** Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- D. **Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting:** Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
  - 1. **Equipment with Multiple Power or Control Sources:** Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
  - 2. **Equipment Requiring Workspace Clearance According to NFPA 70:** Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- E. **Instruction Signs:**
  - 1. **Operating Instructions:** Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
  - 2. **Emergency Operating Instructions:** Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- F. **Equipment Identification Labels:** On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
  - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
  - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
  - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
  
2. Equipment to Be Labeled:
  - a. Panelboards, electrical cabinets, and enclosures.
  - b. Access doors and panels for concealed electrical items.
  - c. Electrical switchgear and switchboards.
  - d. Transformers.
  - e. Emergency system boxes and enclosures.
  - f. Receptacles with panel and circuit numbers.
  - g. Disconnect switches.
  - h. Enclosed circuit breakers.
  - i. Power transfer equipment.
  - j. Contactors.

### 3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service feeder branch-circuit service, feeder, and branch-circuit conductors.
  1. Color shall be factory applied factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 26 05 53

## SECTION 26 09 23 – LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Time switches.
  - 2. Outdoor photoelectric switches.
  - 3. Daylight-harvesting controls.
  - 4. Indoor occupancy sensors.
  - 5. Lighting contactors.
  - 6. Emergency shunt relays.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

#### 1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Layout of all devices on floor plan. Work to be done in electronic form such as AutoCAD. Manufacture shall provide a design to accommodate proper coverage throughout.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Color of all wall mounted devices of this section shall match color of devices and plates of the wiring device section.

## 1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Grasslin Controls Corporation; a GE Industrial Systems Company.
  - 2. Intermatic, Inc.
  - 3. Leviton Mfg. Company Inc.
  - 4. Lightolier Controls; a Genlyte Company.
  - 5. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 6. Paragon Electric Co.; Invensys Climate Controls.
  - 7. Square D; Schneider Electric.
  - 8. TORK.
  - 9. Touch-Plate, Inc.
  - 10. Watt Stopper (The).
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
  - 1. Contact Configuration: DPDT.
  - 2. Contact Rating: 30-A inductive or resistive, 240-V ac.
  - 3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
  - 4. Programs: 2 channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule.
  - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
  - 6. Astronomic Time: All channels.
  - 7. Battery Backup: For schedules and time clock.
- C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: DPDT.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
  2. Grasslin Controls Corporation; a GE Industrial Systems Company.
  3. Intermatic, Inc.
  4. Lithonia Lighting; Acuity Lighting Group, Inc.
  5. GreenGate.
  6. Paragon Electric Co.; Invensys Climate Controls.
  7. Square D; Schneider Electric.
  8. TORK.
  9. Touch-Plate, Inc.
  10. Watt Stopper (The).
- B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
  2. Time Delay: 15-second minimum, to prevent false operation.
  3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
  4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- C. Description: Solid state, with DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
  2. Time Delay: 30-second minimum, to prevent false operation.
  3. Lightning Arrester: Air-gap type.
  4. Mounting: Twist lock complying with IEEE C136.10, with base.

## 2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Lighting.
  2. Leviton Mfg. Company Inc.
  3. Lithonia Lighting; Acuity Lighting Group, Inc.
  4. GreenGate.
  5. Sensor Switch, Inc.
  6. Watt Stopper (The).
- B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
    - a. When no daylight is present (target level).
    - b. When significant daylight is present.
  2. System programming is done with two hand-held, remote-control tools.
    - a. Initial setup tool.
    - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Sensor Output: zero to 10 V dc to operate luminaires. Sensor is powered by switch/controller.
  3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lx).
- E. Relay Unit:
1. Analog System: Dry contacts rated for 20 A LED load at 120 and 277 V ac, for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V ac. Sensor has 24 V dc, 150 mA, Class 2 power source.
    - a. Plenum rated.
  2. Digital System: Digital controller capable of accepting three or four 8PSJ inputs with two outputs rated for 20 A incandescent or LED load at 120 and 277 V ac , for 16 A LED at 120 and 277 V ac, and for 1 hp at 120 Vac. Sensor has 24 V(dc) Class 2 power source.
    - a. With integral current monitoring.
    - b. Compatible with digital addressable lighting interface.
    - c. Plenum rated.

## 2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Lighting.
  2. Leviton Mfg. Company Inc.
  3. Lithonia Lighting; Acuity Lighting Group, Inc.
  4. GreenGate.
  5. Sensor Switch, Inc.
  6. Watt Stopper (The).
- B. General Requirements for Sensors:
1. Wall- or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  2. Separate relay unit.
  3. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  4. Operation:
    - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  5. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  6. Relay Unit: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  7. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  8. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  9. Bypass Switch: Override the “on” function in case of sensor failure.
  10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); turn lights off when selected lighting level is present.
  11. Wall mounted devices color shall match color selected for switches and receptacles. Refer to other sections in specifications.

12. Meet Nema WD 7-2011 requirements.
- C. PIR Type: Ceiling-mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
- E. Dual-Technology Type: Ceiling-mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. The particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
- F. System and Design Requirements:
1. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
  2. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.
  3. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

4. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
5. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits
6. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
7. Meet Nema WD 7-2011 requirements.

## 2.5 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Allen-Bradley/Rockwell Automation.
  2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  3. Eaton Electrical Inc.; Cutler-Hammer Products.
  4. GE Industrial Systems; Total Lighting Control.
  5. Grasslin Controls Corporation; a GE Industrial Systems Company.
  6. Hubbell Lighting.
  7. Lithonia Lighting; Acuity Lighting Group, Inc.
  8. MicroLite Lighting Control Systems.
  9. Square D; Schneider Electric.
  10. TORK.
  11. Touch-Plate, Inc.
  12. Watt Stopper (The).
  13. Siemens
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
  1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The drawings indicate only the rooms which are to be provided with sensors. The contractor shall provide sensors as required to properly and completely cover the respective room.
- B. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
- C. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
- D. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein. Drawings may indicate the room in which occupancy sensor control is required. The contractor and manufacture shall provide a device to provide proper coverage of the area.

### 3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be **1/2 inch (13 mm)**.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.
- C. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 23

## SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

#### 1.2 SUBMITTALS

- A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Wiring and connection diagrams.
- C. Output Settings Reports: Record of tap adjustments specified in Part 3.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C 57.12.91.
- C. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting DOE 2016, Class 1 efficiency levels when tested according to DOE 2016.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

#### 1.5 COORDINATION

- A. Coordinate installation of wall-mounting and structure-hanging supports.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cutler-Hammer
  - 2. GE Electrical Distribution & Control
  - 3. Olsun
  - 4. Siemens Energy & Automation, Inc
  - 5. Square D/Groupe Schneider NA

### 2.2 MATERIALS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Copper.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, DOE 2016 and list and label as complying with UL 1561.
- B. Provide transformers that are internally braced to withstand seismic forces specified in "Seismic Controls for Electrical Work."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated, NEMA 250, Type 2.
- E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection."
  - 1. Finish Color: Gray.
- F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- G. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  - 2. Indicate value of K-factor on transformer nameplate.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- M. Transformers shall be energy efficient per DOE 2016 standards.

#### 2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

#### 3.3 CONNECTIONS

- A. Ground equipment according to NFPA-70.

- B. Connect wiring according to "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. .

#### 3.4 ADJUSTING

- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 26 22 00

## SECTION 26 24 16 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

#### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

## 1.10 FIELD CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Architect's written permission.
  - 3. Comply with NFPA 70E.

## 1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
  - 2. Height: 84 inches maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 6. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
- G. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
  - a. Plating shall run entire length of bus.
  - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As per schedule
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on electronic circuit breakers.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on the schedules.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door

shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

- F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.
  - 1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  - 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
  - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - i. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - k. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - l. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
  - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 "Fuses."
2. Fused Switch Features and Accessories:
  - a. Standard ampere ratings and number of poles.
  - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

## 2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover. Typed written.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.

- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
  - 3. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.
- L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- N. Mount spare fuse cabinet in accessible location.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 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.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

## SECTION 26 27 26 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Single and duplex receptacles, ground-fault circuit interrupters and isolated-ground receptacles.
  - 2. Single- and double-pole snap switches.
  - 3. Device wall plates.
  - 4. Pin and sleeve connectors and receptacles.
  - 5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Receptacles, switches, plates, floor outlets, poke through assemblies, service poles and multioutlet assemblies.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70 latest edition or edition enforced by state or local code authority.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Outlets - Duplex:
    - a. Hubbell Incorporated- HBL 5362.
    - b. Leviton Mfg. Company Inc.-5362.
    - c. Pass & Seymour-CRB5362.
    - d. Pass & Seymour -PT5362A (Plug Tail Device).
  - 2. Switches-Single Pole:
    - a. Hubbell Incorporated - HBL 1221.
    - b. Pass & Seymour - PS20AC1.
    - c. Leviton Mfg. Company, Inc.- 1221-1
  - 3. Switches-Three Pole:
    - a. Hubbell Incorporated - HBL1223
    - b. Leviton Mfg. Company, Inc.-1223-2.
    - c. Pass & Seymour-PS20AC3.
  - 4. Dimmer Switches Line Voltage:
    - a. Lutron Nova T
    - b. Pass & Seymour CD2000

\* Dimmer must be compatible with Ballast or LED Driver.
  - 5. Dimmer Switches 0-10V:
    - a. Synergy ISD
    - b. Cooper SF10P

\* Dimmer must be compatible with Ballast or LED Driver.
  - 6. GFI Receptacles: Weather Resistant:
    - a. Hubbell Incorporated - GFWRST20
    - b. Leviton Mfg. Company Inc.-GFWR2
    - c. Pass & Seymour- 2097TRWR
  - 7. GFI Receptacles: Weather Resistant and Tamper Resistant:
    - a. Hubbell Incorporated - GFTWRST20

- b. Leviton Mfg. Company Inc.-GFWT2
  - c. Pass & Seymour- 2097TRWR
8. Receptacles: Tamper Resistant:
    - a. Hubbell Incorporated - BR20TR.
    - b. Leviton Mfg. Company Inc.-TBR20
    - c. Pass & Seymour- TR5362.
  9. USB Charger Duplex Receptacles:
    - a. Hubbell Incorporated – USB20AC
    - b. Leviton – T5833

## 2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with UL 498, 20 amp.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade 20 amp.
- C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

## 2.3 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.4 SWITCHES

- A. Single- and Double-Pole Switches: Comply with UL 20, 20 amp.
- B. Snap Switches: Heavy-Duty grade, quiet type 20 amp, 120/277 volt.
- C. Line Voltage Dimmer: 120V, 2000 watt, slide to-off. Dimmer must be compatible with ballast or driver.
- D. 0-10V Dimmer: 120/277VAC, capable of three way, max wattage 1200 w 120VAC, 150000 277 VAC, Dimmer must be compatible with ballast or driver. 100% to 1% continuous.

## 2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: **As selected by Architect.**
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Wet Locations: Heavy duty die-cast metal, gasketed with powdercoat finish and lockable tab. Listed and labeled “extra duty”, “in-use”, for use in "wet locations”.

## 2.6 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
  - 1. Service Outlet Assembly: Recessed type with three (3) compartments that allow for up to three (3) duplex receptacles and/or 12 communication ports and/or 10 AV devices.
  - 2. Size: Selected to fit nominal 6-inch (100-mm) cored holes in floor and matched to floor thickness.
  - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  - 4. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

## 2.7 FINISHES

- A. Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.2.
  - 2. Wiring Devices Connected to Emergency Power System: Red.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- C. Remove wall plates and protect devices and assemblies during painting.
- D. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- E. Install weather resistant receptacles in damp and wet locations per N.E.C. requirements.

- F. Install tamper resistant receptacles in homes, apartments, hotel rooms and daycares per N.E.C. requirements.

### 3.2 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
  - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 27 26

## SECTION 26 28 13 – FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Cartridge fuses rated 600 V and less for use in switches.

#### 1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
  - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 2. Fuse size for elevator feeders and elevator disconnect switches.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

#### 1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ferraz Shawmut, Inc.
  - 2. Little Fuse.

### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
- B. End Caps: End caps shall be capable of being tested if fuse is blown.
- C. Indicating Feature: Fuse shall have an indicating feature which clearly indicates when fuse is blown.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK1, time delay.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### 3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

## SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
  - 1. Feeder and branch-circuit protection.
  - 2. Motor and equipment disconnecting means.

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Current and voltage ratings.
    - c. Short-circuit current rating.
    - d. UL listing for series rating of installed devices.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
3. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.6 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Fusible Switches:
    - a. Eaton Corp.; Cutler-Hammer Products, K-Series.
    - b. General Electric Co.; Electrical Distribution & Control Division, TH.
    - c. Siemens Energy & Automation, Inc., VBII.
    - d. Square D Co, 3110.

### 2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

## 2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

## 2.4 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in "Basic Electrical Materials and Methods."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- C. If the disconnect or enclosed circuit breaker is used as a Main Service Disconnect then the maximum available fault current shall be listed on the device to meet the requirements of NFPA 70:110.24. The labeling shall be engraved plastic. The maximum available fault current shall be obtained from the electrical utility for the secondary side of the utility transformer.

### 3.3 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- D. Maintain all necessary clearances per NFPA-70.

### 3.4 FIELD QUALITY CONTROL

#### A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

### 3.5 ADJUSTING

#### A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.6 CLEANING

#### A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 28 16

## SECTION 26 43 13 – SURGE PROTECTION DEVICES FOR SERVICE ENTRANCE AND BRANCH PANELS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION/SCOPE

- A. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1 or Type 2 devices per UL1449 5th Edition, applied to the line or load side of the utility feed inside the facility.
- B. A SPD located at Service Entrance and Distribution and Branch Panels, Switchgear, Motor Control Centers, and Switchboard assemblies as indicated on the drawings.
- C. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devices.

#### 1.2 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
  - 1. UL 1449 5th Edition.
  - 2. UL 1283.
  - 3. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - 4. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
  - 5. UL96A
  - 6. IEEE 1100 Emerald Book.
  - 7. National Fire Protection Association (NFPA 70: National Electrical Code).

#### 1.3 SUBMITTALS/QUALITY ASSURANCE – SUBMIT THE FOLLOWING:

- A. Package must include shop drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.
- B. Copies of Manufacturer's catalog data, technical information and specifications on equipment proposed for use.
- C. Copies of documentation stating that the Surge Protection Device is listed by UL to UL1449 5th Edition, category code VZCA.
- D. Copies of actual let through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.

- E. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50 kHz and 100 MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.
- F. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.
- G. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURER FOR *TYPE C SPD's for Service Entrance Application:*

- A. Current Technology – Transguard3 or TG3 Series **150kA** per mode surge rating or ASCO 460 series.
- B. Approved equivalent. Submission package must be received by engineer 2 weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

### 2.2 MANUFACTURED UNITS/ ELECTRICAL REQUIREMENTS

- A. Refer to drawing for operating voltage, configuration and surge current capacity per mode for each location, or you may list locations and information here.
- B. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 5th Edition, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.
- C. Unit shall have no more than 10% deterioration or degradation of the UL1449 5th Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated category C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.
- D. Protection Modes UL1449 5th Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 5th Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

- E. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.
1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.
- F. Integral Disconnect Switch (IF REQUIRED)
1. The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
  2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
  3. The switch shall be rated for 600Vac.
  4. The SPD device shall be tested to UL1449 5th Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.
  5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
  6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.
- G. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.
- H. The UL1449 Nominal Discharge Surge Current Rating shall be 20Ka
- I. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.
- J. The SPD shall be listed as Type1 SPD, suitable for use in Type1 or Type2 applications.
- K. The SPD shall have the following monitoring options.
1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
  2. SPD monitoring shall track surge protection and display it as a percentage
  3. SPD shall provide a surge counter with three categories to be defined as

Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)

2.3 APPROVED MANUFACTURER FOR **TYPE B SPD's for Branch Panel Application:**

- A. Current Technology – Transguard3 or TG3 Series 50 kA per mode surge rating or ASCO 460 series.
- B. Approved equivalent. Submission package must be received by engineer 2 weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

2.4 MANUFACTURED UNITS/ ELECTRICAL REQUIREMENTS

- A. Refer to drawing for operating voltage, configuration and surge current capacity per mode for each location, or you may list locations and information here.
- B. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 5th Edition, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.
- C. Unit shall have no more than 10% deterioration or degradation of the UL1449 5th Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated category C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.
- D. Protection Modes UL1449 5th Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 5th Edition section 37.6:

System Voltage	Mode	MCOV	B3	C3 Comb.	UL 1449
			Ringwave 6kV, 500A	Wave 20kV, 10kA	Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

- E. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.
  - 1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

F. Integral Disconnect Switch (IF REQUIRED)

1. The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
3. The switch shall be rated for 600Vac.
4. The SPD device shall be tested to UL1449 5th Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.
5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

G. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

H. The UL1449 Nominal Discharge Surge Current Rating shall be 20kA

I. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.

J. The SPD shall be listed as Type1 SPD, suitable for use in Type1 or Type2 applications.

K. The SPD shall have the following monitoring options available.

1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
2. SPD monitoring shall track surge protection and display it as a percentage
3. SPD shall provide a surge counter with three categories to be defined as  
Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)

### PART 3 - EXECUTION/INSTALLATION

3.1 STARTUP - The SPD manufacturer's technician shall perform a system checkout and start-up in the field to assure proper installation, operation and to initiate the warranty of the system. The technician will be required to do the following:

- A. Verify voltage clamping levels utilizing a diagnostic test kit, comparing factory readings to installed readings.
- B. Verify N-G connection.
- C. Record information to a product signature card for each product installed.

3.2 Unit may be installed on either the line or load side of the main service disconnect. If installed on the line side unit shall be installed with an integral disconnect. If installed on the load side the unit shall be installed on the largest breaker size available. If installed lead length exceeds 5' installer shall use a low impedance (HPI) cable to reduce the lead lengths effect on the installed performance of the SPD.

#### PART 4 - PRODUCT WARRANTY

4.1 Warranty on defective material and workmanship shall be for 15 years.

4.2 Copy of Warranty to be sent with submittal.

END OF SECTION 26 43 13

## SECTION 26 51 00 – INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

#### 1.2 REFERENCES

- A. ANSI/NFPA 70, National Electrical Code
- B. IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- C. FCC 47 CFR Part 15, Federal Code of Regulation (CFR) testing standard for electronic equipment
- D. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- E. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- F. UL1598, Standard for Safety of Luminaires
- G. NEMA SSL 3-2010, High-Power White LED Binning for General Illumination

#### 1.3 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, and accessories.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
  - 1. Dimensions of fixtures.
  - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
  - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
  - 4. Emergency lighting unit battery and charger.
  - 5. Fluorescent and high-intensity-discharge ballasts.
  - 6. Types of lamps.

- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
  - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Submit product data on luminaires. Product data to include, but not limited to materials, finishes, approvals, photometric performance, and dimensional information.
- D. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in the front-end documents.

#### 1.5 DRAWINGS

- A. The drawings, which constitute a part of these specifications, indicate the general location of the luminaires. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
- B. Photometric layout shall meet or exceed the criteria of the fixtures indicated on drawings.

#### 1.6 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- D. LED Luminaires
  - 1. Manufactures of LED luminaires shall demonstrate a suitable testing program incorporating high heat, high humidity, and thermal shock test regimens to ensure system reliability and to substantiate lifetime claims.
  - 2. The use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.
  - 3. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.
  - 4. Luminaires shall be provided with a 5-year warranty covering LEDs, drivers, paint, and mechanical components.

#### 1.7 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

## 1.8 WARRANTY

- A. General Warranty: The contractor shall warranty all work for one year after acceptance of project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Fixture schedule on the drawings. Manufacture shall submit for prior approval where required at least (10) days prior to bid.
- B. Subject to compliance with these specifications, luminaires shall be manufactured by the manufacturer indicated on the drawings or prior approved equivalent.

### 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

### 2.3 EXIT SIGNS

- A. Internally Lighted Signs: As follows:
  - 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

### 2.4 LAMPS

- A. Fluorescent Color Temperature and Minimum Color-Rendering Index: Refer to drawings.
- B. 4-foot lamps shall be 28-watt, 68,000 rated life 12 hour on with instant start ballast and 90,000 12 hours on with programmable start. Initial lumens 2650, minimum CRI of 82 and 96% lumen maintenance. The approved lamp is Philips Energy Advantage.
- C. All fluorescent lamps shall be low on mercury.

## 2.5 LED LUMINAIRES

- A. General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Material and specifications for each luminaire are as follows:
1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply)
  2. Each luminaire shall be rated for a minimum operational life of 50,000 hours and to LM-70 lumen depreciation standards. This life rating must be conducted at 40°C ambient temperature.
  3. The rated operating temperature range shall be -30°C to +40°C.
  4. Each luminaire can operate above 100°F [37°C], but not expected to comply with photometric requirements at elevated temperatures.
  5. Photometry must be compliant with IESNA LM-79 and shall be conducted at 25°C ambient temperature.
  6. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
  7. Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.
  8. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an equivalent standard from a nationally recognized testing laboratory.
- C. Technical Requirements
1. Electrical
    - a. Power Consumption: Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.
    - b. Operation Voltage: The luminaire shall operate from a 60 HZ  $\pm$ 3 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
    - c. Power Factor: The luminaire shall have a power factor of 0.90 or greater.
    - d. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.
    - e. Each Luminaire shall have UL Listed Class II power supplies. Class I power supplies will not be acceptable.
    - f. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
    - g. RF Interference: LED Drivers must meet Class A emission limits referred to in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
    - h. Drivers shall have a Class A sound rating.
  2. Thermal Management
    - a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
    - b. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.

- c. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
- d. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.
- e. The heat sink material shall be aluminum.

## 2.6 FIXTURE SUPPORT COMPONENTS

- A. Comply with "Basic Electrical Materials and Methods," for channel- and angle-iron supports, and nonmetallic channel and angle supports.
- B. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.
- C. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- D. Aircraft Cable Support: Use cable, anchorages, and intermediate support recommended by fixture manufacturer.

## 2.7 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
  - 2. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- C. Suspended Fixture Support: As follows:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

### 3.2 CONNECTIONS

- A. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Provide instruments to make and record test results.
- C. Tests: As follows:
  - 1. Verify normal operation of each fixture after installation.
  - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
  - 3. Verify normal transfer to emergency source and retransfer to normal.
  - 4. Report results in writing.
- D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- E. Corrosive Fixtures: Replace during warranty period.

### 3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

END OF SECTION 26 51 00

## SECTION 26 56 00 – EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires, lamps, ballasts, poles/support structures, and accessories.

#### 1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Materials and dimensions of luminaires and poles.
  - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
  - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
  - 4. High-intensity-discharge luminaire ballasts.
  - 5. LED and Driver information.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- C. Maintenance Data: For lighting units to include in maintenance manuals specified in specifications.

#### 1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction
- B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

#### 1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

- A. Store poles on decay-resistant treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

#### 1.7 WARRANTY

- A. General Warranty: The contractor shall warranty all work for one year after acceptance of the project for HID and fluorescent and (5) year after acceptance of the project for LED.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Fixture schedule on the drawings. Products indicated in the fixture schedule shall meet the requirements of this specification. Manufacture shall submit for prior approval where required at least (10) days prior to bid.

#### 2.2 HID / FLUORESCENT LUMINAIRES

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- D. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.

1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
3. Open-circuit operation will not reduce average life.
4. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
5. Noise: Uniformly quiet operation, with a noise rating of B or better.

## 2.3 LUMINAIRE SUPPORT COMPONENTS

- A. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 110 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
- B. Finish: Match finish of pole/support structure for arm, bracket, and Tenon mount materials.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  1. Materials: Will not cause galvanic action at contact points.
  2. Mountings: Correctly position luminaire to provide indicated light distribution.
  3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
  4. Anchor-Bolt Template: Plywood or steel.
- D. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Concrete for Pole Foundations: Comply with "Cast-in-Place Concrete."
  1. Design Strength: 3000-psi (20.7-MPa), 28-day compressive strength.

## 2.4 LED LUMINAIRES

- A. General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules. The luminaires need to meet the requirements below.
- B. Material and specifications for each luminaire are as follows:
  1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).

2. Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night. This life rating must be conducted 40C ambient temperature.
3. The rated operating temperature range shall be -30°C to +40°C.
4. Each luminaire is capable of operating above 100°F [37°C], but not expected to comply with photometric requirements at elevated temperatures.
5. Photometry must be compliant with IESNA LM-79 and shall be conducted at 25°C ambient temperature.
6. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
7. Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.
8. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an equivalent standard from a nationally recognized testing laboratory.

#### C. Technical Requirements

##### 1. Electrical

- a. Power Consumption: Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.
- b. Operation Voltage: The luminaire shall operate from a 60 HZ  $\pm$ 3 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
- c. Power Factor: The luminaire shall have a power factor of 0.90 or greater.
- d. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.
- e. Surge Suppression: The luminaire on-board circuitry shall include fused surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10 kV (minimum) and transient peak currents up to 5 kA (minimum). SPD shall conform to UL 1449 depending of the components used in the design. SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category C (standard). The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.
- f. Each Luminaire shall have integral UL Listed Class II power supplies. Class I power supplies will not be acceptable.
- g. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

- h. RF Interference: LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- i. Drivers shall have a Class A sound rating.

## 2. Photometric Requirements

- a. Optical Assemblies: LEDs shall be provided with discreet over optical elements to provide IESNA Type II, III, IV or V distributions. Additional distributions for spill light control shall be utilized when light trespass must be mitigated. Mitigation must take place without external shielding elements. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions street side efficiencies shall be a minimum of 80%. All LEDs and optical assemblies shall be mounted parallel to the ground. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.
- b. Illuminance: The illuminance shall not decrease by more than 30% over the expected operating life. The measurements shall be calibrated to standard photopic calibrations.
- c. Light Color/Quality: The luminaire shall have a correlated color temperature (CCT) range of 4,000K to 4,500K. The color rendition index (CRI) shall be 70 or greater. Binning of LEDs shall conform to ANSI/ G. NEMA SSL 3-2010.
- d. Backlight-Uplight-Glare: The luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical. The luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical. Backlight and Glare ratings as per fixture schedule and calculated per IESNA TM-15.

## 3. Thermal Management

- a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
- b. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
- c. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
- d. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.
- e. The heat sink material shall be aluminum.

## 4. Physical and Mechanical Requirements

- a. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the luminaire shall be integral to the unit.

- b. The assembly and manufacturing process for the LED luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.
- c. Luminaires shall be capable of withstanding cyclical loading in (G = Acceleration of Gravity): a minimum peak acceleration level of 3.0 G peak-to-peak sinusoidal loading with the internal driver installed, for a minimum of 100,000 cycles without failure of any luminaire parts. Testing to be performed in three planes: a horizontal plane parallel to the direction of mounting, a horizontal plane perpendicular to the direction of mounting and the vertical plane.
- d. The housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire, and carry dust and other accumulated debris away from the unit.
- e. The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components
- f. The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet location.
- g. Each mounted luminaire may be furnished with or without a photoelectric unit receptacle as per fixture schedule.
- h. Door shall be hinged and secured to the housing in a manner to prevent its accidental opening.
- i. The circuit board and power supply shall be contained inside the luminaire. Electrolytic capacitors used in the power supplies shall be rated for -40°F to 220°F (-40°C to +105°C), long life (> 5000 hours), and operated at no more than 70% of their rated voltage, and 70% of rated current.

## 5. Materials

- a. Housings shall be fabricated from materials that are designed to withstand a 3000-hour salt spray test as specified in ASTM Designation: B117.
- b. Each refractor or lens shall be made from UV inhibited high impact plastic such as acrylic and be resistant to scratching.
- c. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The len(s) of the luminaire are excluded from this requirement.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Concrete Foundations: Construct according to Section "Cast-in-Place Concrete."

1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Section "Cast-in-Place Concrete" for exposed finish.

B. Install poles as follows:

1. Use web fabric slings (not chain or cable) to raise and set poles.
2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
3. Secure poles level, plumb, and square.
4. Grout void between pole base and foundation. Use nonshrinking or expanding concrete grout firmly packed in entire void space.
5. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

C. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

### 3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

B. Ground metal poles/support structures according to Section "Grounding."

### 3.3 FIELD QUALITY CONTROL

A. Inspect each installed unit for damage. Replace damaged units.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

### 3.4 CLEANING AND ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer.

B. Contractor to aim any adjustable luminaires per architect, engineer or owner's requirements. Contractor to provide aiming at night and provide all necessary equipment needed to aim luminaires.

END OF SECTION 26 56 00

## SECTION 26 56 68 – EXTERIOR ATHLETIC LIGHTING

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for St Julien Park using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following venues:
  - 1. Pickleball Courts
- D. The primary goals of this sports lighting project are:
  - 1. **Guaranteed Light Levels:** Selection of appropriate light levels impacts the safety of players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 25 years.
  - 2. **Environmental Light Control:** It is the primary goal of this project to minimize spill light to adjoining properties and glare to players, spectators, and neighbors.
  - 3. **Cost of Ownership:** To reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
  - 4. All lighting designs shall comply with these specifications.
  - 5. **Control and Monitoring:** To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid. The remote on/off control and monitoring system shall seamlessly integrate and be compatible with the park's existing athletic lighting control system currently in place.

#### 1.2 ONFIELD LIGHTING PERFORMANCE

- A. **Illumination Levels and Design Factors:** Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting manufacturers will provide a guarantee that light levels will be sustained over the life of the warranty period. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified below.

Manufacturers will provide lumen maintenance data of the LED luminaires used per TM-21-11 and will incorporate the lumen maintenance projections into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Per IES guidelines, lumen maintenance hours should be reported based on the 6x multiplier of testing hours.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Pickleball Courts	50 Footcandles	2.0:1.0	42	10' x 10'

- B. Color Temperature: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.
- C. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare onfield and providing sufficient upright.
  - 1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
  - 2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvres. No symmetrical beam patterns are acceptable.
  - 3. Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaire with lesser glare control to meet field angle requirements of section 1.2.C.1.

# of Poles	Pole Designation	Pole Height
6	P1-P6	40'

1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers, and external shields. No symmetrical beam patterns are accepted.
- B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

	Average	Maximum
150' Specified Spill Line Horizontal Footcandles	.05 fc	.05 fc
150' Specified Spill Line Max Vertical Footcandles	.05 fc	.05 fc
150' Specified Spill Line Max Candela (taken at 5 ft above grade)		225 cd

- C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be provided in 30-foot intervals along the boundary line at 3 ft above grade.
- D. Sample Photometry: The first page of a photometric report for all luminaire types proposed

showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

- E. Field Verification: Lighting manufacturer shall supply field verification of environmental light control using a meter calibrated within the last 12 months:
  - 1. Spill verification: Illumination levels shall be taken in accordance with IESNA RP-6-22. The light sensing surface of the light meter should be held 36 inches above the playing surface with the sensing surface horizontal (for horizontal readings) or vertically pointed at the brightest light bank (for max vertical readings)

#### 1.4 COST OF OWNERSHIP

- A. Manufacturer shall submit a 25 year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

### PART 2 – PRODUCT

#### 2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:
  - 1. Galvanized steel poles and cross-arm assembly.
  - 2. Non-approved pole technology:
    - a. Square static cast concrete poles will not be accepted.
    - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.

3. Lighting systems shall use concrete foundations. See Section 2.4 for details.
  - a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
  - b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-enforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
4. Manufacturer will supply all drivers and supporting electrical equipment.
  - a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.
  - b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2\_2002.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
7. Control cabinet to provide remote on-off control and monitoring of the lighting system. See Section 2.3 for further details.
8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
  - a. Integrated grounding via concrete encased electrode grounding system.
  - b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.
9. Enhanced corrosion protection package: Due to the potentially corrosive environment for this project, manufacturers must provide documentation that their products meet the following enhanced requirements in addition to the standard durability protection specified above:
  - a) Exposed carbon steel horizontal surfaces on the crossarm assembly shall be galvanized to no less than a five (5) mil average thickness.
  - b) Exposed die cast aluminum components shall be Type II anodized per MIL-STD-8625 and coated with high performance polyester.
  - c) Exposed extruded aluminum components shall be Type II anodized per MIL-

STD-8625 and coated with high performance polyester.

10. Poles shall include 120V, 20A GFCI, weather and tamper resistant type convenience outlets with lockable weatherproof, steel covers located at the base (24" A.F.G.). See drawings.

D. Safety: All system components shall be UL listed for the appropriate application.

## 2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

1. Electric power: 480 Volt, 3 Phase
2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the sports lighting system shall be less than 15.0 kW.

## 2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.

D. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, email).

E. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show

current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS and Android devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility.
  2. Report hours saved by using early off and push buttons by users.
- H. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.
- I. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

## 2.4 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the 2021 International Building Code. Wind loads to be calculated using ASCE 7-16, an ultimate design wind speed of 140 and exposure category C.
- B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).
- C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report.
- D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

## PART 3 – EXECUTION

### 3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
1. Providing engineered foundation embedment design by a registered engineer in the State of Louisiana for soils other than specified soil conditions;
  2. Additional materials required to achieve alternate foundation;
  3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

### 3.2 DELIVERY TIMING

- B. Delivery Timing Equipment On-Site: The equipment must be on-site 10-12 weeks from receipt of approved submittals and receipt of complete order information.

### 3.3 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative,

illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-22.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as “guaranteed” on the illumination summary provided by the manufacturer.
2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.
- B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

PART 4 – DESIGN APPROVAL

4.1 PRE-BID SUBMITTAL REQUIREMENTS

- A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.1.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.
- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.

NOTE: The specifications and addendum are used to denote the quality and utility of the desired product and do not restrict bidders to a specific brand, make or manufacturer. Products may be acceptable if determined by the design professional to be functionally

equivalent and/or of equal utility and appearance to the criteria stated herein in accordance with the Public Bid Law. The “REQUIRED SUBMITTAL INFORMATION” assists the design professional to make such a determination.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED)  
10 DAYS PRIOR TO BID

*All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.*

Yes / No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: <ul style="list-style-type: none"> <li>a. Field Name, date, file number, prepared by</li> <li>b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x &amp; y), Illuminance levels at grid spacing specified</li> <li>c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics</li> <li>d. Height of light test meter above field surface.</li> <li>e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor.</li> </ul>
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Louisiana, if required by owner.
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of Louisiana.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Louisiana.

J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Louisiana.
K	Project References	Manufacturer to provide a list of 10 projects where the technology and specific fixture proposed for this project has been installed in the state of Louisiana. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
L	Product Information	Complete bill of material and current brochures/cut sheets for all products being provided.
M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

The information supplied herein shall be used for the purpose of complying with the specifications for St Julien Park Pickleball and Tennis. By signing below, I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: \_\_\_\_\_

Signature: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Contractor: \_\_\_\_\_

Signature: \_\_\_\_\_

## SECTION 28 31 11 – FIRE ALARM SYSTEM WITH VOICE EVACUATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes fire alarm systems.
- B. Definitions:
1. FACP: Fire alarm control panel.
  2. LED: Light-emitting diode.
  3. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- C. System Description:
1. Noncoded, Analog addressable system; multiplexed signal transmission dedicated to fire alarm service only.
- D. Performance Requirements:
1. Comply with NFPA 72 latest edition or edition enforced by state or local code authority.
  2. Fire alarm signal initiation shall be by one or more of the following devices:
    - a. Manual stations.
    - b. Heat detectors.
    - c. Smoke detectors.
    - d. Automatic sprinkler system water flow.
  3. Fire alarm signal shall initiate the following actions:
    - a. Alarm notification appliances shall operate continuously and be synchronized as required per code.
    - b. Identify alarm at the FACP and remote annunciators.
    - c. Transmit an alarm signal to the remote alarm receiving station.
    - d. Shut down heating, ventilating, and air-conditioning equipment over 2000 cfm.
    - e. Record events in the system memory.
  4. Supervisory signal initiation shall be by one or more of the following devices or actions:
    - a. Operation of a fire-protection system valve tamper.
  5. System trouble signal initiation shall be by one or more of the following devices or actions:
    - a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.



- b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
  - c. Loss of primary power at the FACP.
  - d. Ground or a single break in FACP internal circuits.
  - e. Abnormal ac voltage at the FACP.
  - f. A break in standby battery circuitry.
  - g. Failure of battery charging.
  - h. Abnormal position of any switch at the FACP or annunciator.
6. Resetting of other systems:
- a. Resetting of duct detectors shall be from the panel.

## 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
  - 2. Device Address List: Coordinate with final system programming.
  - 3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
  - 4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
  - 5. Batteries: Size calculations.
  - 6. CAD drawings with device locations, device ratings, cable routing, cable size/type, etc. indicated on floor plans.
  - 7. All shop drawings are to be electronic in nature and submitted in PDF form. Paper shop drawings will not be reviewed.
- C. Field quality-control test reports per NFPA 72.
- D. Operation and maintenance data.
- E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Complete all required form. Contractor is responsible for all required fees. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review. All drawings shall be done in AutoCAD R14 format or newer.
- F. All fire alarm drawings are to be submitted digitally. Fire alarm devices with any notation are to clearly stand out from the floor plan by using a bolder line width contrasting a screened floorplan. Devices and notation are to be proportionally sized to the scale of the drawing. Fire

alarm devices only are to be indicated on drawings, drawings are not to be shared with electrical devices or any other discipline.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
  - a. Electronic media shall be provided to Architect and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project and shall be supervised by a Nicet Level III Supervisor.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. FACP and Equipment:
    - a. Siemens.
    - b. Silent Knight
    - c. Notifier.
    - d. Fire Lite.
    - e. EST.
    - f. Honeywell
  2. Wire and Cable:
    - a. Comtran Corporation.
    - b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
    - c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
    - d. West Penn Wire/CDT; a division of Cable Design Technologies.
    - e. Coleman Cable.

## 2.2 FACP

### A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Analog addressable control circuits for operation of mechanical equipment.
3. System shall be sized for the number of points indicated plus (20) twenty percent spare.

### B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

### C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.
2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
3. Circuits shall be configured with loop isolators.
4. Actuation of alarm notification appliances, annunciation, and elevator recall shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

### D. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

### E. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

### F. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

### G. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter. The system shall be capable of communicating and telephone lines.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory signal and supervisory and digital alarm communicator transmitter and digital alarm radio transmitter shall be powered by the 24-V dc source.
  - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
  - 1. Power supply shall have a dedicated fused safety switch or circuit breaker for this connection at the service entrance equipment. The switch box or circuit breaker shall have red marking identify it with "FIRE ALARM SYSTEM POWER." Where a circuit breaker is the disconnecting means, an approved breaker locking device shall be installed.
  - 2. Provide surge protection on all 120 volt power serving fire alarm equipment.
- J. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
  - 1. Battery and Charger Capacity: Comply with NFPA 72.
  - 2. Provide surge protectors on all circuits.
- K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- L. Voice/Alarm Signaling Service: A central emergency communication system with supervised microphone, preamplifier, amplifier, and tone generator provided in a separate cabinet or as a special module that is part of the FACP.
  - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
    - a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.
  - 2. Notification-Appliance Circuits: NFPA 72, Class B.
  - 3. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

## 2.3 MANUAL FIRE ALARM PULL STATION

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
  2. Station Reset: Key- or wrench-operated switch.

## 2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

B. Multi Criteria Detectors:

1. Minimum of photoelectric and heat.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
3. Photoelectric Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
4. Thermal detection.

C. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

D. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
  - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
  - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.5 HEAT DETECTORS

- A. General: UL 521 listed.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.
  1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
  1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

## 2.6 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
  1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly. Factory standard color by Architect (Red or Beige).
- B. Voice/Tone Speakers:
  1. UL 1480 listed.
  2. High-Range Units: Rated 2 to 15 W.
  3. Low-Range Units: Rated 1 to 2 W.
  4. Mounting: Flush, semi-recessed, or surface mounted; bidirectional as indicated.
  5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
- C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  1. Rated Light Output: Candela indicated on drawings.

2. Strobe Leads: Factory connected to screw terminals.
3. Where multiple visual notification appliances can be seen from any location, circuitry shall be incorporated for the synchronization of flash rate.
4. Adjustable Strobes-Field selectable from 15cd, 30cd, 75cd, 110cd.

## 2.7 SPRINKLER SYSTEM REMOTE INDICATORS

- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
  1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

## 2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall and to a circuit-breaker shunt trip for power shutdown.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated. The

contractor shall provide conduit and cable to telephone backboard and make final connections to telephone service.

- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

#### 2.11 CELLULAR COMMUNICATOR TRANSMITTER

- A. Napco Starlink Fire LTE Commercial or approved equal.
- B. UL Listed.
- C. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically communicates to the central station. When contact is made with the central station(s), the signal is transmitted.
- D. If needed remote antennas shall be installed to allow for communications to monitoring company.
- E. Communicator shall be compatible with the owner's monitoring company.
- F. Communicator shall be powered by the FACP.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

#### 2.12 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet and Modbus protocol for connection to building automation system.

#### 2.13 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
  - 1. Twisted shielded pair, NFPA 70 Article 760, UL listed as Type FPLP, plenum rated and complying with requirements in UL 1424.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.12 Station Smoke and Carbon Monoxide Detectors:

1. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
2. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72
3. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
4. Auxiliary Relays: One Form C, rated at 0.5 A.
5. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
6. Visible Notification Appliance: 177-cd strobe.
7. Heat sensor, 135 deg F (57 deg C) combination rate-of-rise and fixed temperature.
8. Test Switch: Push to test; simulates smoke at rated obscuration.
9. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
10. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
11. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
12. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
13. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
14. Comply with UL 2075

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- C. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- D. Audible Alarm-Indicating Devices: Install per NFPA 72. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

- E. Visible Alarm-Indicating Devices: Install per NFPA 72.
- F. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- G. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- H. The contractor shall provide the following spare devices at a location determined by the engineer or fire marshal prior to final approval of shop drawings. Contractor shall be responsible for all conduit, wire, battery, cards etc. needed to install these spare devices. Devices not used shall be delivered to the owner as spare. Devices: 6 - horn/strobes (any candela), 4 - pull stations, 4 - smoke detectors, and 4 - control modules.

### 3.2 WIRING INSTALLATION

- A. Install wiring according to the following:
  - 1. NECA 1.
  - 2. TIA/EIA 568-A.
- B. Wiring Method:
  - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable. Cable installed in plenum ceiling spaces shall be plenum rated. Fire alarm cable installed in walls, exposed areas or in inaccessible spaces shall be in conduit. All cable and conduit shall be concealed where possible.
  - 2. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to "Basic Electrical Materials and Methods Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM CIRCUIT CONTROL."

### 3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
  - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
  - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
  - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
    - a Detectors that are outside their marked sensitivity range shall be replaced.
  - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Provide a minimum of 2 hours of training to the Owner's Representative.

**M & E Consulting, Inc.**  
**1304 Bertrand Drive, Suite F-7**  
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Dear Contractor:

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**Please complete this form completely and email to [cad@meconsulting.com](mailto:cad@meconsulting.com) .**

END OF SECTION 28 31 11

## SECTION 323113 - CHAIN LINK FENCES AND GATES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Chain-link fences.
  - 2. Swing gates.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of fence 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 of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

[Verify available warranties and warranty periods for units and components.](#)

- 1. Warranty Period: Five 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 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7 :
  - 1. Design Wind Load: As indicated on Drawings.
    - a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed **10 feet (3 m)** for Material Group IC, electric-resistance-welded round steel pipe.
    - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
    - c. Refer to section 116600 Athletic Equipment for windscreen that shall be provided with all perimeter fencing.
      - 1) Delegated engineering design shall include and account for wind screening into the fence design.

### 2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Steel Wire for Fabric: Wire diameter of **0.148 inch (3.76 mm)**.
    - a. Mesh Size: **2 inches (50 mm)**.
    - b. Vinyl-Coated Fabric:
      - 1) Color: As selected by Architect from manufacturer's full range, according to ASTM F934.
  - 3. Selvage: Twisted top and knuckled bottom.

### 2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
  - 1. Fence Height: As indicated on Drawings.
  - 2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.

- a. Line Post: 2.875 inches (73 mm) in diameter.
  - b. End, Corner, and Pull Posts: 4.0 inches (102 mm).
3. Horizontal Framework Members: Intermediate top and bottom rails according to ASTM F1043. (for 3'-6" tall fencing, intermediate rail may be omitted)
  4. Brace Rails: ASTM F1043.
  5. Vinyl coating over zinc coating.
    - a. Color: As selected by Architect from manufacturer's full range, according to ASTM F934.

## 2.4 TENSION WIRE

- A. Vinyl-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, tension wire according to ASTM F1664, over-coated steel wire.
  1. Color: As selected by Architect from manufacturer's full range, according to ASTM F934.

## 2.5 SWING GATES

- A. General: ASTM F900 for gate posts and single & double swing gate types.
  1. Gate Leaf Width: As indicated.
  2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
- B. Pipe and Tubing:
  1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
  2. Gate Posts: Round tubular steel.
  3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Hardware:
  1. Hinges: 180-degree outward swing.
  2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  3. Lock: Manufacturer's standard internal device.
  4. Include hold opens on each gate. Set galvanized steel sleeve in walk for hold open rods.

## 2.6 FITTINGS

- A. Provide fittings according to ASTM F626.

## 2.7 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. 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 fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
- C. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on Drawings. For runs exceeding **500 feet (152 m)**, space pull posts an equal distance between corner or end posts.
- D. Line Posts: Space line posts uniformly at **10 feet (3 m)** o.c.
- E. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with **0.120-inch- (3.05-mm-)** diameter hog rings of same material and finish as fabric wire, spaced a maximum of **24 inches (610 mm)** o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along bottom of fence fabric.
- F. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch (25-mm) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to 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 323113

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<u>SECTION NUMBER</u>	<u>TITLE</u>
<b>III</b>	<b>Technical Specifications</b>
III-1	Technical Specifications for Sanitary Sewerage Systems
III-1.1	Sanitary Sewerage System (Gravity Flow)
III-1.2	Sanitary Sewerage Service Connections
III-2	Technical Specifications for Wastewater Lift Stations
III-2.4	Submersible Sewage Pump Station
III-3	Technical Specifications for Sanitary Sewerage Force Main
III-8	Technical Specifications for Water Distribution System
III-8.1	Installation of Water lines
III-8.2	Valves, Hydrants, Fittings and Services
III-13	Technical Specifications for Miscellaneous Concrete Works
III-14	Technical Specification for Culverts and Storm Drains
III-15	Technical Specification for Storm Drainage Manholes, Inlets, Junction Boxes, and Catch Basins
III-21	Technical Specifications for Excavation, Embankment, Grading and Shaping for Roadway and Ditches
III-37	Technical Specifications for Fertilizer and Seeding
III-37.2	Technical Specifications for Fertilizer and Seeding (Hydroseeding/Hydromulching)



**TECHNICAL SPECIFICATIONS  
FOR  
SANITARY SEWERAGE SYSTEMS**

**1.1 SANITARY SEWERAGE SYSTEM  
(GRAVITY FLOW)**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all supervision, labor, tools, plant, equipment, appliances and materials required to perform and satisfactorily complete all items of work in connection with the construction of a gravity flow sewage collection system.

**ARTICLE 2 - MATERIALS**

Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of AWWA or the appropriate ASTM standard. Submit manufacturer's certifications that ductile iron pipe and fittings meet requirements of the appropriate ANSI standard. Submit a certificate of compliance from the manufacturer stating the chemical and physical properties of the materials used and are in conformance with the specifications.

**A. PVC GRAVITY SEWER PIPE**

PVC gravity sewer pipe and fittings for depths less than 12' shall be in accordance with ANSI/ASTM D 2241, SDR 26, 12454-B PVC cell classification in accordance with ASTM D 1784; additives and fillers shall not exceed 10 parts (by weight) per hundred of PVC resin in the compound.

PVC gravity pipe and fittings for depths greater than 12' shall be in accordance with ANSI/ASTM D2241, SDR 26, 12454-B PVC cell classification in accordance with ASTM D 1784. Additives and fillers shall not exceed 10 parts (by weight) per hundred of PVC resin in the compound.

Joints shall be push on type in accordance with ASTM D 3212. Flexible elastomeric seals (gaskets) shall be in accordance with ASTM F 477. PVC pipe shall be supplied in nominal laying lengths of 20'. The color of pipe shall be green. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation.

Solvent cements shall be in accordance with ASTM D 2564.

**B. CAST IRON GRAVITY SEWER PIPE**

Cast iron pipe for gravity sewer (CISP) shall be centrifugally cast with push on joints. CISP shall be in complete accordance with the requirements of "Thickness Design of Cast-Iron Pipe" ANSI/AWWA C101 or latest revision thereof. Thickness of pipe barrel shall be calculated using the following criterion: Iron Strength 21/45, Internal Pressure 50 psi, Laying Condition B.

**C. DUCTILE IRON GRAVITY SEWER**

Ductile iron pipe for gravity sewer (DISP) shall be centrifugally cast with push-on joints. Pipe shall be in complete accordance with "Ductile Iron Gravity Sewer Pipe" Designation A746 for ANSI/ASTM or latest revision thereof. Pipe shall have flexible lining and wall thickness shall be in accordance with ANSI A21.50 for Class 50 pipe wall thickness

(Table 50.14); asphalt coated outside and cement lined and seal coated inside in accordance with ANSI A21.4/AWWA C104.

Joints shall be push on (boltless, single gasketed) similar to that known as "Super-Bell-Tite", "Fastite", "Tyton", or approved equal; or, mechanical joint in accordance with ANSI A21.11 / AWWA C111, corrosion resistant high strength low alloy steel bolts and nuts ("Cor-Ten").

Ductile iron fittings shall be in accordance with ANSI 21.10/AWWA C110.

#### **D. FUSED PVC**

Fusion-joined PVC pipe and fittings shall be made from clean, virgin NSF approved Type I, Grade I PVC conforming to ASTM Resin Specification D1784-65T.

(4"-24") Fusion-joined PVC pipe shall be Fusible AWWA C-900, Standard dimension ratio SDR 18, 235 psi pressure, NSF approved, 12454 B PVC compound conforming to ASTM Resin Specification D1784.

Fusion-joined PVC shall be joined by a pipe manufacturer-certified technician with manufacturer approved equipment and shall include a means of logging fusion process data.

The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. PVC pipe shall be supplied in nominal laying lengths of 20'. The color of pipe shall be green. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation. The chemical compounds for fusion-joined PVC pipe shall be formulated to facilitate the thermal-fusion process.

#### **E. POLYETHYLENE PIPE (P.E. PIPE)**

P.E. Pipe shall be in accordance with PE 4710, minimum cell classification valves shall be 445576C in accordance with ASTM D3350, 160 psi pressure rating, SDR 13.5.

Joints shall be butt fused.

Fittings shall be molded from a polyethylene compound having a cell classification equal to or exceeding the pipe compound; supplied by the same manufacturer of the pipe being supplied. Transition Fittings shall be a mechanical joint adapter (Harvey Adapter) fabricated from HDPE pipe conforming to ASTM 3350. The adapter shall have a pre-positioned stainless steel stiffener and shall offer full axial restraint, by means of a restraining gland. Payment for Harvey Adapters is included in the unit price for installation of P.E. Pipe.

HDPE sewer force main pipe shall have a green colored stripe along the entire exterior length of the pipe. Sample of pipe and physical and chemical data sheets shall be supplied to the Engineer for approval and his approval shall be obtained before pipe is purchased. The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. At the option of the owner, manufacturers may be disqualified if they do not have proper experience in the manufacture of the material specified.

#### **F. JOINING PIPE OF DIFFERENT MATERIAL**

Pipe of dissimilar material shall be connected with manufactured adapters specifically intended for this purpose. Devices shall be manufactured by Fernco or approved equal.

#### **G. MANHOLES (MATERIALS FOR MANHOLES)**

Precast reinforced concrete manholes (shaft, cone top and base pad construction) shall conform completely to ANSI/ASTM C478 or latest revision thereof with an integral base pad.

Watertight connectors shall be flexible watertight connectors in accordance with ASTM C923 and shall be KOR-N-SEAL (NPC Systems, Inc.), Z-LOK XP (A-LOK Products, Inc.) or approved equal.

The manhole cover and frame shall be the size and type shown on the "Typical Sewer Details".

Asphaltic varnish shall be in accordance with DOTD Standard Specification Section 1008.07.

#### **H. STAINLESS STEEL WATERTIGHT MANHOLE INSERT**

Insert and all components shall be manufactured from corrosion proof materials suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with wastewater collection systems.

The insert shall be manufactured of 304 stainless steel with a thickness of not less than 18 gage.

The insert shall have a configuration such that the lip will rest on the seating surface of the manhole frame.

In order to reduce excess weight accumulation, the insert shall not exceed 6-1/2" in overall depth.

The gasket shall be manufactured of close cell neoprene or approved equal. The gasket shall be compatible with the stainless steel insert to form a long lasting bond in wet or dry conditions.

The watertight manhole insert as specified above, upon installation as per manufacturer's recommendations, shall not allow more than one gallon of inflow during a period of 24 hours.

The manhole insert shall have a handle of 3/16" minimum plastic coated stainless steel cable attached to the insert body. The handle shall be attached with a No. 6 high grade stainless steel rivet. The cable shall be braided in a manner which resists cutting with common bolt cutters. The cable terminal and eye shall be stainless steel.

**I. AGGREGATE**

Gravel shall consist of hard, durable, siliceous particles reasonably free of sticks and other deleterious matter, and when tested in accordance with DOTD Designation TR113 shall meet the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
1-1/2"	95 - 100
No. 4	0 - 15
Clay and silt (DOTD TR112)	2% Maximum

Reef or clam shell for maintenance of existing street crossings, driveways, sidewalks, etc., or for final dress-up of streets and driveways shall consist of not more than 5% foreign material by dry weight.

Limestone shall be 610 limestone conforming to the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
1-1/2"	100
1"	90 - 100
3/4"	70 - 95
3/8"	50 - 80
No. 4	35 - 65
No. 10	25 - 50
No. 40	10 - 26
No. 200	4 - 12

**J. CONCRETE**

Cement shall be portland cement conforming to ASTM C150. Tests for compressive strength of concrete shall be in accordance with ASTM C39.

Concrete for Type III foundations (embedment) and service risers shall have a minimum compressive strength of 3000 psi at 28 days and shall contain not less than 5 sacks of cement per cubic yard and not more than 7 gallons of water per sack of cement.

Concrete for driveways and manhole bottoms shall have a minimum compressive strength of 3500 psi at 28 days and shall contain not less than 5-1/2 sacks of cement per cubic yard and not more than 7 gallons of water per sack of cement.

Concrete for streets shall have a minimum compressive strength of 4000 psi at 28 days and shall contain not less than 6 sacks of cement per cubic yard and not more than 6 gallons of water per sack of cement.

Grout shall consist of one part portland cement, two parts mortar sand and water as required for proper consistency. Grout shall be used within 30 minutes of mixing.

#### K. GRANULAR MATERIAL (SAND)

Granular material shall be non-plastic, having clean, hard, durable, siliceous grains; and when tested in accordance with DOTD Designations TR 112 and TR 113, shall meet the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
1/2"	100
No. 10	75 - 100
No. 200	0 - 15

#### L. MORTAR SAND

Mortar sand shall be non-plastic siliceous material conforming to the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
No. 4	100
No. 8	95 - 100
No. 100	0 - 25
No. 200	0 - 10

Percentage of foreign matter shall not exceed the following:

Coal or Lignite	0.25%
Clay Lumps	0.50%

#### M. FIL-CRETE

Fil-Crete shall be a cementitious grout mixture of sand, cement, and water in the following proportions:

Portland Cement	188 Pounds
Clean Sand	3010 Pounds
Water	46.2 Gallons

The above mix design will produce one (1) cubic yard of mixture, considering a 5.7% moisture content in the sand aggregate.

#### N. CLASS A-6 SOIL

Class A-6 soil shall conform to Louisiana DOTD Designation TR 423 with a plasticity index between 11 and 20 and a liquid limit of 40 free of all foreign matter.

**O. ASPHALTIC CONCRETE**

All required asphaltic concrete pavement shall be either Type 1 or 3 wearing course mix (with Grade AC-30 Asphalt Cement) conforming to the "Louisiana Standard Specifications for Roads and Bridges", latest edition, by the Louisiana Department of Transportation and Development, Office of Highways.

**P. TIMBER SHEET PILES**

Timber sheet piles shall be untreated unless specifically stated otherwise on the plans. The piles shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together during driving. The piles unless otherwise specifically noted on the plans or in the Special Conditions shall be in accordance with Section 812, of DOTD Standard specifications for Roads and Bridges, and may consist of any species which will satisfactorily stand driving. It shall be sawn or hewn with square corners and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions and other defects which might impair its strength or tightness.

**Q. CASING**

Casing shall be welded smooth steel pipe conforming to API 5L Grade B or ASA B36.10, coated inside and outside with asphalt or painted with two (2) coats of bitumastic paint. Wall thickness shall be 0.375 inches minimum unless a greater thickness is shown on the construction plans. Joints shall be welded. Ends of casing shall be properly sealed.

Spacers shall be installed around the carrier pipe inside the casing. The casing spacers shall be constructed of stainless steel bands with abrasion resistant dielectric runners. The casing spacers shall be installed at a spacing and location recommended by the manufacturer. Casing spacers shall be Model SSI Stainless Steel Casing Spacers by Advance Products and Systems, or approved equal.

**ARTICLE 3 - ALIGNMENT AND GRADE****A. BATTERBOARD METHOD**

Prior to excavation, the Engineer shall set an offset line of hubs at fifty (50) foot intervals parallel to and at a uniform distance from the center line of the sewer. Cuts to the invert of the sewer and offset from the center line of the sewer will be provided to the Contractor on cut sheets. Stations and offset data will be marked at each hub to correspond to the cut sheet. The Contractor shall be responsible for establishing the center line of sewer from the hubs placed by the Engineer. After the trench is excavated to grade and prior to laying any sewer pipe, the Contractor shall transfer the elevations from the hubs to batterboards level and at an even foot height above the invert grade of the sewer line at intervals not to exceed fifty (50) feet. Intermediate batterboards may be sighted in between those set at grade stake locations. At least four (4) batterboards shall be in place at any time to facilitate checking the grade line. Batterboards shall be a minimum size of 1" by 6" S4S and shall be of lumber selected especially for trueness of line. A taut line, stretched over the batterboards parallel to the true centerline of the sewer, shall be used with a plumb bob and proper grade pole to control pipe laying.

**B. LASER METHOD**

Prior to excavation the Engineer shall set an offset line of hubs at proposed locations of manholes. Cuts to the invert of the sewer and offset from the centerline of the sewer will be provided to the Contractor on cut sheets. Stations and offset data will be marked at each hub to correspond to the cut sheet. The Contractor shall be responsible for establishing the centerline of the sewer from the hubs placed by the Engineer. Prior to laying sewer pipe, the Contractor shall set the laser beam on exact horizontal and vertical alignment of the centerline of the sewer. The Contractor shall be required to provide a transit with tripod and range pole on the job site at all times suitable for laser set up and maintenance of horizontal alignment. The Contractor shall be required to provide a level with tripod and level rod on the job site at all times suitable for laser set up and maintenance of vertical alignment. The laser equipment, transit, level, tripods, range pole, and level rod shall be in good condition and the acceptability of these items of equipment shall be subject to approval of the Engineer.

The Engineer or his representative shall have access, at all times, to the above referenced equipment for inspecting horizontal and vertical control. The Contractor shall be entirely responsible for errors in horizontal or vertical alignment resulting from misuse or failure of Contractor's equipment. Where horizontal and vertical alignment of any installed

pipe is determined by the Engineer to be unacceptable, the Contractor shall uncover, relay and backfill the necessary sewer pipe as directed by the Engineer to correct the erroneous alignment at the Contractor's expense.

### **C. ADVANCE NOTICE FOR CONSTRUCTION STAKING**

The Contractor shall notify the Engineer at least two working days prior to the time staking of hubs is required.

### **ARTICLE 4 - CUT SHEETS AND LOCATION OF HOUSE CONNECTIONS**

The Engineer will furnish the Contractor two copies of the cut sheets. The Contractor will set up batterboards or laser equipment from dimensions furnished on these cut sheets. As house connections are constructed along the sewer line, the Contractor will record the exact distance from the house connection to the closest downstream manhole along the line on the cut sheet.

Immediately after all house connections are installed the Contractor shall measure and make record of the station and length of each service on the cut sheet. The Contractor shall return one copy of the cut sheet to the Engineer for his records. All manhole stubouts shall be recorded on the cut sheet (coordinates relative to center of manhole and a projection of the effluent sewer line).

It shall be the responsibility of the Contractor to furnish to the Engineer accurate measurements of all house connection locations.

### **ARTICLE 5 - EXCAVATION AND TRENCHING**

The Contractor shall perform all excavation of whatever substance encountered, to the depths indicated on the drawings or specified herein. If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate or in any way change the line and profile shown on the drawings, the excavation and backfill required by said change shall be performed by the Contractor under the terms of these specifications. Any excavation beyond the authorized depths shall be filled with suitable compacted material without cost to the Owner.

All excavation shall be by open cut, except where indicated otherwise in the plans. The trench width at the top shall not exceed five (5) feet. The minimum trench width to a point two (2) feet above the top of the pipe installation shall not exceed the external diameter of the barrel of the pipe, plus nine (9) inches on each side. Additional cost for special foundation and backfill material and requirements as a result of failure to confine the excavation to this width shall be borne by the Contractor.

The banks of trenches shall be kept as nearly vertical as practicable and, where required to control trench width, protect adjacent structures, and safeguard employees, shall be properly sheathed and braced. Trench slopes, shores, benches, and/or trench boxes shall comply with the latest provisions of OSHA 29 CFR Part 1926, Subpart P, Occupational Safety and Health Standards, Excavations.

Where, in the opinion of the Engineer, damage is liable to result from withdrawing sheathing, the sheathing will be required to be left in place. All grading in the vicinity of trenches and other excavations shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the trenches or other excavations shall be removed by pumping or by other approved methods at no additional cost to the Owner prior to laying pipe. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance back from the edges of the excavation to avoid overloading and to prevent slides or cave-ins.

The Contractor shall control the banks of all excavated areas as is necessary to prevent movement of soil in areas supporting existing foundations, slabs, utility line poles, pipelines or other structures. If, as a result of the excavation or through fault or neglect of the Contractor, the earth or ground under or around such foundations, slabs, utility line poles, pipelines, or other structures slips or is otherwise disturbed, corrective measures, as directed by the Engineer, shall be taken by and at the expense of the Contractor.

Keep all drains, gutters, culverts, etc., for surface drainage open, or if they are unavoidably closed, make other provisions for this drainage. Length of the trench to be opened or the area of surface to be disturbed and unrestored at any one time will be limited by the Engineer with regard to both expeditious construction and the convenience and comfort of persons residing in the neighborhood or frequenting the street in question.

No trenches shall be left open during non-working hours.

The Contractor shall notify the Engineer at least two working days prior to commencing trenching operations.

#### **ARTICLE 6 - SEWER PIPE INSTALLATION**

Where a certain pipe material is specified on the plans, only that material can be used. Where the term "Sewer Pipe" or "Sanitary Sewer Pipe (SSP)" is shown on the plans or in the proposal, it shall be interpreted to mean any of the specified pipe materials meeting the requirements of this section, as the Contractor elects, of the dimension shown on the plans.

Install pipe in accordance with the manufacturer's recommendations and in accordance with the specifications herein. In addition, install PVC pipe in accordance with ASTM D 2321; and install clay pipe in accordance with ASTM C 12.

Install solvent weld cap on the new line entering the first manhole constructed immediately upstream of the existing manhole to prevent sewer gases from entering the work area and to prevent drainage into the existing system.

Thoroughly clean interior of pipe before lowering into the trench. Keep pipe interior clean and free of foreign matter during laying operations.

Do not lay pipe in unsuitable weather conditions. Stabilize wet trench conditions before laying pipe. Plug open ends of pipe and fittings when work is not in progress.

Replace any pipe found to be defective, before or after laying, with new pipe by and at the expense of the Contractor.

Use embedment material for pipe bedding as directed by the Engineer. Grade pipe bedding by hand to provide uniform pipe bearing for its entire length and to provide proper grade and alignment. Provide bell or coupling holes at each joint to permit proper joint assembly and pipe support. Lay pipe with spigot end pointing in direction of flow.

Walking or working on the completed sewer pipe, except as may be necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to a height of at least one (1) foot above the top of the pipe.

Check each joint of pipe for line and grade before the next succeeding joint is placed.

Maintain proper alignment of pipe during haunching and initial and final backfilling operations.

Keep the sewer line pumped dry at all times.

Under no conditions shall sewer pipe be laid against the wall of the trench. The minimum distance from exterior of pipe to trench wall shall be six (6) inches. Extra precaution shall be taken to prevent rocks or other large objects from lodging against the pipe during backfill.

As soon as each length of pipe has been properly placed and jointed, the spaces between the pipe and sides of the trench shall be carefully backfilled with earth, no particle of which shall be larger than will pass through a one (1) inch ring. The backfill shall be compacted as specified in this section of these specifications. Each joint shall be checked for line and grade before the next succeeding joint is placed.

It is the duty of the Contractor to investigate the subsurface conditions prior to submitting a bid. No sewer pipe shall be placed in a wet trench or on an unstable trench bottom.

If an unstable soil is encountered, the pipe shall be placed on a foundation of a design approved by the Engineer.

#### **ARTICLE 7 - CASING INSTALLATION**

Clean and coat weld joints with approved bitumen compound after joining and before installation.

Casing shall be so installed as to prevent formation of waterway below the obstruction traversed (roadway, building, etc.). It shall have even bearing throughout its length and shall slope toward one end. Length of casing shall be in conformance with Department of Transportation and Development, Office of Highways requirements for permits, where roadways, or highways are traversed or as shown on the plans, or established by the Engineer, whichever length is appropriate. Where the ends of the casing are below the ground, they shall be sealed to suitably protect against entrance of foreign material which might

prevent ready removal of carrier pipe. Where the ends of the casing are at or above ground surface and above high water level, they may be left open, provided drainage is afforded in such a manner that leakage will be conducted away from the roadbed or structure.

Provide polyethylene or stainless steel casing spacers attached to the sewer pipe to prevent damage to pipe and bell joints during installation and to provide proper long term line support, at no additional cost. Skid arrangement to be in accordance with manufacturer's recommendations. Spacers shall be manufactured by Advance Products and System, Inc., or approved equal.

#### **ARTICLE 8 - JACKING OR BORING**

Install pipe by means of a boring machine, auger, jack, or by other means satisfactory to the Engineer.

In the event the jacking or boring operations result in injury or damage to railroad tracks or pavements, repairs shall be the responsibility of the Contractor and shall be done at no additional cost.

Any overcutting of the borehole shall be remedied by pressure grouting the entire length of the installation. Backfill boring pits to the bottom of the pipe with limestone at no additional cost.

Schedule jacking or boring operations such that no pits shall be left open at the end of the day.

Adequate sheathing and bracing shall be provided to prevent earth slides or cave-ins. Trench slopes, shores, benches, and/or trench boxes shall comply with the latest provisions of OSHA 29 CFR 1926 - Subpart P, Occupational Safety and Health Standards - Excavations.

#### **ARTICLE 9 - SEWER PIPE CONNECTIONS**

##### **A. CLAY PIPE**

All vitrified clay pipe and fittings six (6) inch through twelve (12) inch shall have PEP compression couplings conforming to ASTM C 594, or latest revision. All other sizes of vitrified clay pipe joints shall conform to ASTM C 425, or latest revision. Plain end vitrified clay pipe with factory molded joints shall be connected by first brushing upon the mating surfaces the proper lubricant sealer as recommended by the pipe manufacturer. The spigot end shall be centered into the compression coupling end of the last down stream clay pipe length and shoved into place and properly seated with the application of a moderate force, by a pry or level device, against a circular wood back resting inside the compression coupling against the pipe. The pipes shall be joined no later than five (5) minutes after the application of the lubricant sealer.

CISP or DISP connections to clay pipe shall be made with adapters specifically manufactured for that purpose.

##### **B. PVC SEWER PIPE**

All joints shall be assembled making certain the bell and gasket are clean and the spigot end is free of all foreign matter. The spigot end shall then be lubricated and inserted into the bell by applying a constant pressure and not by stabbing. After assembly, the gasket shall be checked to make sure it has not twisted.

##### **C. DISSIMILAR MATERIAL**

Cast or ductile iron pipe shall be connected to PVC pipe or clay pipe using flexible couplings and stainless steel worm drive hose clamps manufactured by Fernco or approved equal.

#### **ARTICLE 10 - BACKFILLING**

As soon as the joints have been completed and approved by the Engineer, the space under the haunches of the pipe and up to the spring line shall be filled with acceptable material, free from attached stones, hard clay lumps, or other hard substances. Place initial backfill up to a point 12.0" above the top surface of the pipe in layers not exceeding 6.0" thickness, including areas where granular material is used for backfill. Care should be exercised in placing backfill about the haunches of the pipe to avoid displacement. Each layer shall be compacted by hand or mechanical tamping to obtain not less than 85% of maximum density. Maximum density as referred to herein shall be determined in accordance with DOTD Designation TR

401. Care should be taken to avoid contact between the pipe and the compaction equipment.

At the Contractor's option, granular material may be utilized for backfilling roadway crossing without lift thickness controls. Granular backfill shall be compacted to obtain not less than 95% of maximum density at optimum moisture. Granular material shall conform to "Article 2 - Materials" of these specifications. Granular backfill materials that are loosened due to subsequent operations shall be recompacted at the Contractor's expense by approved methods to the required density. The earth backfill adjoining the granular backfill on both ends shall be compacted to 95% of maximum density at optimum moisture to prevent lateral movement of the granular backfill. This adjacent earth backfill shall be no less than five (5) feet in length along the trench on each side of the granular backfill to achieve a total length of roadway crossing as specified in the preceding paragraph.

The Contractor shall be responsible for obtaining suitable compaction of all trench backfill, including that in proposed streets, parking areas or other surfaced locations and shall be responsible for the failure of any surfacing due to trench settlement.

Compaction will be verified through compaction tests ordered by the Engineer at no expense to the Contractor, except as stated herein. If the test results indicate insufficient compaction, the cost for that compaction test and of all retesting shall be borne by the Contractor until satisfactory results are achieved. The Owner will pay only for those tests which prove that the specified compaction has been achieved.

Avoid damage to pipe during compaction.

Backfill material shall contain no stumps or roots and shall be free of lumber, trash, or other debris.

Use special backfill, with Engineer's approval, where the excavated material is not suitable for backfilling the trench and obtaining the required compaction. At the Contractor's option, limestone may be used for special backfill at no additional cost.

Maintain trenches in good and safe condition during construction and during one year warranty period.

Backfill trenches for mains and services beneath existing pavement as follows:

1. Backfill with Class A-6 soil, fil-crete (except in state highway right-of-way) or limestone from the bottom of the trench to the bottom of the proposed pavement. Material used in backfilling shall be included in the unit bid price for "Remove and Replace Asphaltic Street", "Remove and Replace Concrete Street" or "Remove and Replace Drives or Sidewalks". Limit of this backfill condition on either side of the pavement shall not be less than five (5) feet from either edge of such pavement measured perpendicular to edge of road.
2. For A-6 soil backfill or limestone backfill, place material in not more than eight (8) inch lifts with each layer compacted to a minimum 95% of maximum density.

Compact remainder of backfill over and above twelve (12) inches above the surface of the pipe for mains and services laid within the right-of-way as follows:

1. Backfill with select excavated site materials in not more than twelve (12) inch layers with each layer mechanically compacted to a minimum 90% of maximum density.
2. Within state highway right-of-way, the compaction requirements shall be 100% of the density of the surrounding undisturbed material, compacted in layers of not more than twelve (12) inches.
3. Slightly overfill the trench with backfill to create a crowned condition but not to exceed six (6) inches.

Compact remainder of backfill over and above twelve (12) inches above the surface of the pipe for mains and services laid outside the right-of-way as follows:

1. Backfill with select excavated material, in not more than eighteen (18) inch lifts, to the elevation twenty-four (24) inches below the finished ground surface.
2. Compact each layer of the material to eliminate all voids and to obtain a soil density equivalent to the existing undisturbed surrounding soil.

3. Compact the remaining top two (2) feet of the trench backfill, in not more than twelve (12) inch lifts, to obtain a minimum 90% of maximum density.
4. Slightly overfill the trench with backfill to create a crowned condition but not to exceed six (6) inches.

#### **ARTICLE 11 - MANHOLE INSTALLATION**

The excavation for the manholes shall be sufficient to leave six (6) inches clear between their outer surface of the manhole and the embankment or the timber sheathing. Manholes shall be constructed at the locations shown on the cut sheets and/or plans and in accordance with the details shown on the plans. The top of the manholes shall be constructed to the proposed finish grade of the area surrounding the manhole after all construction is complete.

The invert channels shall be smooth, accurately shaped in accordance with the drawings. The remaining surface of the base shall be sloped down toward the channels at a slope of approximately 1/2" per foot.

The frames and covers shall be cast iron of the size and type shown on the plans. Set metal frames in Preco Patch or approved equal. Coat metal castings with asphalt varnish as described in Article 2-F.

Mains and services must extend six (6) inches inside the face of the manhole.

All pipe connections to manholes shall be installed using watertight connectors as per Article 2-F.

Outside drops and services into manholes shall be constructed as shown on the "Typical Sewer Details" with materials meeting all requirements of these specifications.

#### **ARTICLE 12 - WYE BRANCHES OR TEES**

Furnish wye branches or tees with connection of the size specified, securely and permanently fastened to the barrel of the pipe in the process of manufacture.

Wyes and tees shall be given an inclination above a horizontal line and shall be properly bedded.

All wyes and tees shall conform to the specifications and test standards of the pipe it is to be installed on.

Field cut-in wyes or tees will not be permitted.

All services shall be plugged with appropriate air tight plugs.

#### **ARTICLE 13 - SERVICE RISERS**

Install service risers as indicated on the "Typical Sewer Details" at locations shown on the plans or designated in the field by the Engineer.

For sewer mains eight (8) inches or larger, the tee shall be a short-body ductile iron tee conforming to AWWA C153.

#### **ARTICLE 14 - SEWER PIPE FOUNDATIONS**

Typical sewer foundations are as shown on the "Typical Sewer Details".

Type I pipe foundation shall consist of sewer laid on undisturbed soil suitably dished with sufficient bearing capacity to support the sewer line without any additional foundation materials.

Type II foundation shall be aggregate extending full trench width from an elevation six (6) inches below the pipe invert to the horizontal center line of the pipe. Aggregate shall conform to "Article 2 - Materials" of this section of these specifications.

Type III foundation shall be concrete having a minimum strength requirement of 3000 psi at 28 days and shall contain not less than 5 sacks of cement per cubic yard of concrete.

All pipe shall be bedded in a Type I Foundation or as otherwise stated herein, in the plans, or as determined in the field.

Where cuts to inverts of sewer mains are twelve (12) feet or more, Type II foundation shall be required.

Where the bottom of the trench is water bearing soil, or is not sufficiently stable or firm to prevent vertical or lateral displacement of the pipe after installation, the Engineer may direct the Contractor to provide a limestone foundation (Type II) or a concrete cradle (Types III and IV).

#### **ARTICLE 15 - CONNECTION TO EXISTING MANHOLES**

Connection to existing manholes shall be made above the existing manhole base whenever possible.

Watertight connectors shall be provided at the tie-in to the manhole wall. The new sewer pipe should be capped to separate it from the existing system.

Where the connection has to be made at the same elevation as the existing pipe, the base shall be broken only in the area where the connection is to be made and the new base shall conform to the requirements set forth in these specifications.

#### **ARTICLE 16 - EXISTING STRUCTURES**

Existing structures shall be defined as all above and below ground structures, including all pipelines, poles, tracks, roads, culverts, sidewalks, drains, cables, wires, conduits, vaults, manholes, landscaping, and other appurtenant facilities, whether owned or operated by public bodies, private individuals, corporation, firms or companies.

Protect all existing structures from damage during construction.

Utility facilities shown on the plans are approximate locations (not scalable) and do not include service locations. There is no expressed or implied guarantee as to the accuracy of the various utilities or any omissions.

The Contractor shall verify the locations of all utilities and shall adhere to the provisions of OSHA 29 CFR 1926.651 at no cost to the Owner. Final project location will be determined in the field by the Engineer upon the Contractor's verification of all utilities.

In no case shall the Contractor receive additional compensation due to the location of existing utilities in relation to the final location of the proposed lines and appurtenances.

Notify all utilities or other interested parties prior to starting work and advise them of any adjustments required.

Contractor shall be responsible for investigating and informing himself of the condition, character and extent of all structures which may be encountered during construction.

Perform work in a manner to prevent interference with or damage to existing structures. Any damages done by the Contractor shall be his responsibility and all repairs shall be made immediately to the satisfaction of the Engineer.

The Contractor shall be responsible for any damages to or any costs incurred as a result of any delays due to existence, removal, adjustment or repair to any structures mentioned herein, shown on the plans or encountered during construction.

#### **ARTICLE 17 - FLUSHING SEWER LINES**

Prior to removing the plugs from the existing manholes, or connecting new sewer lines to existing manholes, the Contractor shall water flush the sewer line with a sufficient volume of water to cause the pipe to flow at least half full and remove all sand, gravel and other foreign objects which may have lodged in the pipe during construction. All other sewer lines shall be water flushed as described herein prior to final acceptance by the Owner.

#### **ARTICLE 18 - TESTING SEWER LINES**

##### **A. GENERAL REQUIREMENTS**

Sewer lines shall be tested by low pressure air testing and television equipment. Deflection test may also be performed as described in Part E "Deflection Test" of this Article.

The manholes shall be tested by visual inspection, vacuum testing, and infiltration as determined by the Engineer. Manhole leakage will not be acceptable.

Manholes and all sections of sewer lines that fail to meet the test prescribed by the Engineer shall be repaired and retested until they have met the conditions set forth in these specifications for testing at no additional cost to the Owner.

Plugs installed on the new system to prevent sewer gases from entering the work area and to prevent drainage into the existing system shall not be removed until the system has been accepted.

The Contractor shall furnish all equipment, labor, and materials required for conducting the testing set forth herein.

#### **B. MANHOLE INFILTRATION TEST**

1. Construct a minimum 2' deep by 2' wide trench around the manhole.
2. Fill the trench with water and drill ¾" (minimum) holes 5' deep (or the depth of the manhole). These holes shall circle the manhole at 6" intervals.
3. Two hours later the trench shall be refilled with water.
4. Up to two hours after the second filling, the Engineer will check the manhole for infiltration.
5. The manhole will be considered to have passed the test if no infiltration is detected. Repair and retest manholes failing the above test.

#### **C. LOW PRESSURE AIR TESTING**

The low pressure air test shall be performed by the Contractor. The interior of the pipe shall be cleaned immediately prior to the application of the acceptance test. The Contractor shall furnish test plugs, air compressor, test gauges, stop watch, and personnel for conducting the test under the direction and supervision of the Engineer. The Owner shall have the option to have the Contractor's testing equipment independently checked and certified for accuracy at any time.

All pneumatic plugs shall be tested before being used in the actual test installation utilizing the following procedure:

1. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked.
2. Air shall be introduced into the plugs to 25 PSIG.
3. Pressurize the sealed pipe to 5 PSIG.
4. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After pneumatic plugs are checked by the above procedure, place the plugs in the line at each manhole and inflate to 25 PSIG.

Introduce low pressure air into the sealed line until the internal air pressure reaches 4 PSIG greater than the average back pressure of any ground water that may be over the pipe. Allow at least two minutes for the air pressure to stabilize.

After the stabilization period (3.5 PSIG minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply.

The portion of the line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 PSIG (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameter in the following table:

PIPE DIAMETER IN INCHES	MINUTES
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

If ground water is known to be present over the pipe, the Contractor shall install a 1/2" diameter capped pipe nipple, approximately ten (10) inches long, through the manhole wall directly over one of the sewer lines entering the manhole.

This is to be done at the time the sewer line is installed. Immediately prior to the performance of the test, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11.5' above the invert of the pipe, then the added pressure will be  $11.5/2.3$  or 5 PSIG. This increases the 3.5 PSIG to 8.5 PSIG, and the 2.5 PSIG to 7.5 PSIG.) The allowable drop of one pound and the timing remain the same. In no case should the starting test pressure exceed 9.0 PSIG. Recap and seal the pipe nipple to prevent any future infiltration.

In lieu of the above, if the ground water level can be readily determined during the installation of the manhole, and jointly agreed upon by the Contractor and the Engineer, the height of the ground water above the invert of the sewer pipe can be used in determining the pounds of pressure to be added to all readings.

#### **D. TELEVISION TESTING**

Prior to putting each system into service, the line will be visually inspected by television equipment as specified in Section III-1.9 "Cleaning and Television Inspection". The Contractor shall be responsible for cleaning the system prior to inspection by television equipment. If rejected, the Contractor shall perform television testing until proper flushing and/or pipe installation has been achieved at the Contractor's expense.

#### **E. DEFLECTION TEST**

If during the operation of the television equipment there is suspicion of deflection of the sewer pipe, the Engineer reserves the right to require the Contractor to perform a deflection test on that section of pipe at the Contractor's expense.

No pipe shall exceed a deflection of five percent.

Test for deflection using a mandrel with a diameter equal to 95% of the inside diameter of the pipe.

Perform Test without mechanical pulling devices.

Should any deflection test fail, the Engineer reserves the right to require the Contractor to perform deflection tests on any or all additional pipe at no cost to the Owner.

#### **F. MANHOLE VACUUM TEST**

Air vacuum testing of manholes shall be performed on 20% of the manholes installed, minimum of one (1) per contract. The selections of which manholes to be tested shall be determined by the Engineer. All testing shall be paid for by the

contractor.

Test manholes immediately after assemble of the manhole and the connecting pipes and before any backfill is placed around the manhole.

All lift holes and pipe openings are to be plugged before commencement of the test. The test shall be performed using an inflatable compression band, vacuum pump, and appurtenances designed for testing manholes.

After set up is complete, a vacuum of 10" Hg shall be drawn on the manhole. The manhole will be required to maintain the vacuum for one minute without a drop of 1" of Hg.

If the manhole fails the initial test, the Contractor shall locate the leakage and make proper repairs, and retest until a satisfactory test result is obtained.

If any manhole fails the vacuum test, the Engineer reserves the right to require the Contractor to test any or all additional manholes at the Contractor's expense.

#### **G. VISUAL INSPECTION**

After the manholes have been backfilled and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired by the Contractor and the manhole shall be made watertight.

#### **ARTICLE 19 - MAINTENANCE OF TRAFFIC AND COMMUNICATIONS**

Refer to "Louisiana Department of Highways Maintenance Traffic Controls Handbook" (for state highway right-of-way), "The Work Area Traffic Control Handbook" (for City of Lafayette streets), and US Department of Transportation Federal Highway Administration "Manual on Uniform Traffic Control Devices" Part VI, Traffic Controls for Streets and Highway Construction and Maintenance Operations.

The Contractor shall conduct his operations in such a manner so that interference with public travel and inconvenience to the public and to property owners will be minimized. Operations shall be so conducted as to cause minimum interference with access to the property on the streets under construction. The Contractor shall provide and maintain, at his own expense, suitable bridges, detours or other temporary facilities for the accommodation of public or private travel, as directed by the Engineer. Twenty four hour notice to owners of private driveways shall be given prior to interfering with them. Maintenance of traffic may be curtailed providing that the Contractor shall obtain permission from the owner or tenants of private property, or proper public authority, or both, to obstruct traffic within the said limits and time agreed upon. The Contractor shall notify the Engineer immediately of any such agreement. The Contractor shall keep the local fire protection authorities informed at all times of the location of construction operations and fire lanes and shall maintain access for fire fighting equipment as requested by the Fire Department. One-way traffic shall be maintained on all streets during construction, except where suitable detours or other arrangements are agreed to. A flagman (flagmen) shall be provided as required in this section. Upon completion of backfilling of all excavations in roadways and streets, the Contractor shall have a motorized rubber wheel road grader on the job site. This grader shall be used to maintain all streets and roadways in a satisfactory condition approved by the Engineer for the duration of the contract.

The Contractor shall have someone available to take calls at all times. He shall provide the Owner and the Engineer with a night telephone number to call so that he may be advised of any emergency, trouble or other matter requiring his attention.

#### **ARTICLE 20 - CARE OF STREETS, SIDEWALKS, AND ROADS**

The Contractor shall be required, at his own expense, to remove all excess materials, debris or other obstruction from the streets or roads immediately after the backfilling has been completed. Wash the streets and sidewalks daily if necessary to remove the dust problem. No cross streets, sidewalks or roads shall be wholly obstructed except by special permission from the Engineer. If at any time the Contractor neglects to remove such material or obstruction and place streets, sidewalks and roads in suitable condition for traffic within 24 hours after having received written notice from the Engineer, the work may be done by the Owner, and the cost thereof charged to the Contractor and deducted from his final estimate. The Contractor shall repair or replace streets, sidewalks, roads, and culverts to the satisfaction of the Engineer and parties concerned.

**ARTICLE 21 - BARRICADES AND FLARES**

The Contractor shall provide barricades and flares at locations where there exists open holes or trenches or other hazardous obstructions. Said barricades shall bear Contractor's name and a telephone number where he or his representative can be reached at all times. All barricades and flares shall conform to DOTD Section 713 "Temporary Signs, Barricades and Pavement Markings".

**ARTICLE 22 - PROTECTION AND CARE OF PUBLIC OR PRIVATE PROPERTY AND EASEMENTS**

The Contractor shall continuously maintain and protect all underground and above ground structures, utilities, including the restoration of all public utilities, water mains, water services, gas mains, gas services, culverts, drains, ditches, curbs, sidewalks, landscaping and/or other facilities which may be damaged, to a condition at least equal to their original status, at no additional cost to the Owner. In the event of damage to any facilities, the appropriate utility will be notified immediately. The Owner will repair damaged facilities at the Contractor's expense or require the Contractor to repair said damage.

All construction work under this contract on easements, right-of-way, private property or franchise shall be confined to the limits of such easements, right-of-way or franchise. All work shall be accomplished so as to cause the least amount of disturbance and a minimum amount of damage. The Contractor shall schedule his work so that trenches across easements shall not be left open during weekends or holidays, and trenches shall not be left open for more than 48 hours.

Prior to excavation on an easement or private right-of-way, and where required by the Engineer, the Contractor shall strip top soil from the trench or construction area and stockpile it in such a manner that it may be replaced by him, upon completion of construction. No trees or shrubbery shall be removed or trimmed without consent of the Engineer. Ornamental trees and shrubbery shall be carefully removed, with the earth surrounding their roots wrapped in burlap and replanted in their original positions within 48 hours. All shrubbery or trees destroyed or damaged shall be replaced by the Contractor with material of equal quality at no additional cost to the Owner. In the event that it is necessary to trench through any lawn areas, the sod shall be carefully cut, rolled and replaced after the trenches have been backfilled, the backfilling and compacting to be as described for surfaced areas. The lawn area shall then be cleaned, by sweeping or other means, of all earth and debris.

All obstacles such as fences, markers, mail boxes, driveway culverts, etc., shall be removed by the Contractor and immediately replaced after trench is backfilled in their original position and condition at no direct cost to the owner. The Contractor shall notify the Engineer and property Owner at least 24 hours in advance of any work done on easements or right-of-ways.

It is expressly understood that the Contractor shall restore all easements and right-of-ways to a condition equal to their original condition, and in a condition satisfactory to the property owners and the Engineers.

The Contractor shall maintain adequate drainage during the process of construction. Performance of this work is not payable directly, but shall be considered as a subsidiary obligation of the Contractor, covered under the contract price for the construction items.

All trees, stumps, slashings, brush, or other debris removed from the sites as a preliminary to the construction work or during construction, shall be removed from the property and disposed of in a manner approved by the Engineer.

Initial application, when applicable, of maintenance shell or limestone will be paid by the owner. Any subsequent applications necessary due to trench settlement/erosion will be furnished by the Contractor at no cost to the owner.

**ARTICLE 23 - STREET REPAIR**

The Contractor shall remove and replace asphaltic concrete or concrete streets where designated on the plans or where directed by the Engineer. This item of the work shall include the removal of existing pavement, construction of concrete base, curing, and the replacement of the asphaltic concrete pavement in accordance with the specifications and the typical street repair detail shown on the plans. The Contractor shall take care not to remove more pavement than is absolutely necessary. In no case shall compensation be made for removal and replacement of pavement outside the limits set forth in Article 5 of this section, unless the Contractor has written consent of the Engineer.

Pavements, driveways, and sidewalks must be replaced expeditiously and in no case more than 10 working days from the acceptance of lines.

The decision of the Engineer will be final as to the classifying of any form of pavement or surfacing not specified in the

contract or of any forms where the classification is at all doubtful.

In bidding on repairs of pavement made up of two or more courses, all the courses shall be considered as integral parts of the pavement. The price bid shall be for replacement of the pavement complete, including foundation, intermediate course (if present), and surface.

Should the street, sidewalk surfacing, curbs, gutters, bridges, etc., outside the width measured for payment be damaged, cracked, settled, disturbed or injured in any manner by the Contractor's operations, such damage or injury must be replaced and the surfacing, etc., restored to its former condition by the contractor with no separate compensation being made thereof.

Where the street has not been paved but has a hard surface composed of gravel, shell, etc., the Contractor shall save and stockpile such surface material and shall, after the crowned backfill has completely settled or been compacted, replace this material over the trench, making up any deficiency with material of the same character, so as to restore the street surfacing to a condition equal to that in which it was found.

Concrete drives and parking areas shall be restored to the same thickness as the existing surfacing or a minimum of six (6) inches, whichever is greater.

6" x 6" x #6 wire mesh steel reinforcement shall be required for concrete drives and parking areas. Place reinforcement in the middle of the pavement.

Thickness of replaced sections of sidewalks shall be that of the existing thickness or a minimum four (4) inches, whichever is greater.

#### **ARTICLE 24 - REMOVE AND RELAY CULVERTS**

This work shall consist of the excavation of existing culverts for the purpose of installation of sewer main or service line and the relaying of the same pipe back to grade. Culverts shall be cleaned of silt and debris prior to relaying them. The Contractor shall exercise extreme care not to damage culverts and should excessive breakage occur, the Contractor shall, in the opinion of the Engineer, be required to furnish replacement pipe at no direct pay. The Contractor shall furnish new Ram-Nek joint material for all pipe reinstalled.

#### **ARTICLE 25 - REBUILT FENCE**

This work shall consist of the removal and reinstallation of existing fences. Fences shall be rebuilt in a manner which is equal to or better than the condition of the fence upon removal. Rebuilt ornamental fence, picket fence or other special type fence shall be equal in all respects to existing fence. Any fence damaged during removal shall be replaced by the Contractor at no direct pay.

#### **ARTICLE 26 - CLEAN-UP**

Remove from the site all tools, equipment, temporary structures, and surplus materials.

Dispose of all excess soil, waste, rubbish, debris, or objectionable materials off the site and in a manner and a location that complies with local ordinances and laws and is acceptable to all parties concerned and is approved by the Engineer.

When disposal of excess soil is upon private lands, the Contractor shall be required to produce a written agreement with the private landowner stating the agreed terms and conditions.

The entire construction site shall be left clean and to the satisfaction of the Engineer.

#### **ARTICLE 27 - MEASUREMENT AND PAYMENT**

##### **A. GENERAL**

No separate payment will be made for "Excavation and Trenching", "Backfilling", except as specified herein for "Special Backfill for Roadway Crossing", "Maintenance of Traffic", "Care of Streets, Sidewalks and Roads", "Barricades", "Protection of Public or Private Property and Easement", or "Alignment and Grade" and all costs in connection therewith shall be considered incidental to and included in the contract unit price for furnishing and installing sewer lines unless a separate item is provided in the contract proposal.

**B. FURNISHING AND INSTALLING SEWER LINES**

**1. Sewer Main**

Payment for furnishing and installing main sewer lines shall be based on the actual number of linear feet installed, measured horizontally from center of manhole to center of manhole. Any stubs placed in manholes shall be measured horizontally from the plugged end of the stub to the center of the manhole. No deductions from the lengths so determined shall be made for manholes and wyes. Pipe used in service risers shall not be paid for directly but shall be included in the contract unit price for "Service Risers" as specified in Article 25 - Payment - Subpart F - "Service Risers".

Payment for materials, equipment, and labor required in backfilling and tamping to obtain not less than 95% compaction or for granular backfill, whichever method is utilized, below roadway crossings shall be in accordance with Subpart O - "Special Backfill for Roadway Crossings" of this section.

The linear feet of the various size pipes installed at various depths, linear feet measured as herein above specified, will be paid for at the contract unit price per linear foot for "S.S.P." (Sanitary Sewer Pipe) at the size and depth of cut indicated in the contract proposal. The depth of cut for the various sizes of pipe will be the average depth of cut between manholes measured along the center line of the trench. The average depth will be determined by adding the cuts measured for payment at each manhole and at intervals of fifty (50) feet between manholes for Batterboard Method (100' between manholes for Laser Method) and dividing this sum by the number of measurements. In irregular ground, measurements shall be taken at such other spacing as may be needed to determine a true average. Each measurement shall establish the difference in elevation between the computed pipe invert and the existing ground above the pipe at a given station. The invert elevation shall be expressed in hundredths of a foot. The existing ground elevation shall be the elevation derived from a rod reading taken on existing ground to the nearest tenth of a foot. The difference in elevation between the invert and the existing ground shall be rounded to the nearest tenth of a foot. The average determined as described hereinabove shall be expressed in hundredths of a foot. In cases where the average so determined is an exact foot, payment will be made under the bid item for which that exact foot is the upper limit.

<b>EXAMPLE</b>			
<b>COMPUTED INVERT ELEVATIONS (FT.)</b>		<b>EXISTING GROUND ELEVATIONS (FT.)</b>	
STA 0+00	(M. H. 1)	9.84	20.0
STA 0+50		10.02	20.0
STA 1+00	(M. H. 2)	10.18	20.0
MEASUREMENT 1		20.0 - 9.84 =	10.2'
MEASUREMENT 2		20.0 - 10.02 =	10.0'
MEASUREMENT 3		20.0 - 10.18 =	9.8'
AVERAGE		30.0 / 3 =	10.0'
CONTRACT ITEMS:		1. 8" S.S.P.	(8' - 10' CUT)
		2. 8" S.S.P.	(10' - 12' CUT)
PAYMENT:	Contractor to be paid for 100' of 8" S.S.P. at 8' - 10' cut.		

Such payment shall constitute full compensation for all materials, equipment, tools, labor, and supervision necessary to satisfactorily complete all items of work in accordance with these specifications and applicable drawings.

**2. Cast Iron or Ductile Iron Sewer Pipe**

Cast Iron Sewer Pipe (C.I.S.P.) or Ductile Iron Sewer Pipe (D.I.S.P.) shall be measured horizontally from end to end of pipe actually installed and in place. Payment for C.I.S.P. or D.I.S.P. material shall be made in addition to payment for sanitary sewer pipe at the given cut and shall be made at the contract unit price for "C.I.S.P. Material" and shall constitute full compensation for any and all additional material cost, handling, coupling with sanitary sewer pipe as shown on the construction drawings, equipment, supplies, labor, tools, supervision, and fittings necessary to complete the work described herein in accordance with these specifications and applicable drawings. The Contractor shall have the option to use C.I.S.P. or D.I.S.P. at his own discretion. Measurement and payment for "Sanitary Sewer Pipe" shall be made between manholes as described previously herein. No deduction from lengths so determined shall be made where C.I.S.P. or D.I.S.P. is installed in place of S.S.P.

**3. Sewer Services**

Payment for furnishing and installing sewer services shall be based on the actual number of linear feet installed measured horizontally from sewer main to terminus of service line. Any stub placed in a manhole shall be measured horizontally from end to end of pipe actually installed and in place. No deductions from lengths so determined shall be made for sewer fittings.

The linear feet of sanitary sewer pipe service installed at any depth, linear feet measured as hereinbefore specified, will be paid for at the contract unit price per linear foot for "S.S.P. Service" of the size indicated in the contract proposal.

**4. Cast Iron Sewer Services**

Cast Iron Sewer Pipe used for services shall be measured and paid for in accordance with the method described in Paragraph B.2. of this Article 22. Measurement and payment for "S.S.P. Service" shall be made as described previously herein. No deduction from lengths so determined shall be made where cast iron sewer pipe is installed in place of sanitary sewer pipe service.

**C. MANHOLES**

Payment for manholes shall be based on the actual number constructed at the various depths. The depths shall be measured from the invert of the lowest pipe to the top of the manhole cover. In cases where the depth so determined is an exact foot, payment will be made under the bid item for which that exact foot is the upper limit. For related example see Article 25 - Payment - B - Furnishing and Installing Sewer Lines of this section. Manholes shall be paid for at the contract unit price per each for "Manhole" at the depth indicated. The contract price shall include all items used in the construction of manholes including cast iron frame and cover, base and top. Payment for manholes shall constitute full compensation for all materials, equipment, tools, labor, and supervision necessary to satisfactorily complete all items of work on the individual manholes in accordance with these specifications and the plans.

**D. OUTSIDE DROP TO MANHOLE**

Outside drops to manholes for incoming sewers shall be paid for at the contract unit price per each for "Outside Drop to Manhole" at the depth indicated, which shall include vertical pipe, horizontal pipe entering the manhole at bottom, all fittings, all excavation, sheathing and bracing, construction of the wall around the drop pipe, and removal of surface material. The depth shall be the distance measured from the invert of the drop line at the bottom of the manhole to the invert of the incoming sewer.

**E. WYES, TEES, AND BENDS**

Payment for various size of wyes, tees, or bends shall be based on the actual number installed and shall be paid for at the contract unit price per each for "Wye", "Tee", and "Bend" of the size indicated. Such payment shall constitute full compensation for all material, labor, equipment, tools, and supplies necessary to complete all items of the work in accordance with these specifications and plans, including necessary plugs.

**F. SERVICE RISERS**

Payment for service risers shall be at the contract unit price per each for "Service Riser" at the depth indicated measured from invert of sewer main to invert of service line. Such payment shall constitute full compensation for furnishing the service riser, concrete and all other materials, and for all labor, equipment, tools, and supplies necessary to complete all items of work in accordance with these specifications and plans. Tees and compression couplings shall be included in the bid price for "Service Riser". Wyes and bends shall be paid by unit price as specified above.

**G. SHEATHING LEFT IN PLACE**

Payment for sheathing left in place shall be based on the actual sheathing ordered to be left in place by the Engineer and shall be paid for at the contract unit price per thousand board feet of "Sheathing Left in Place".

**H. FOUNDATION TYPE II**

No separate payment shall be made for "Foundation Type II" and all cost in connection therewith shall be considered incidental to and included in the contract unit price for furnishing and installing sewer lines unless a separate item is provide in the contract proposal.

**I. FOUNDATION TYPE III**

Foundation Type III shall be measured horizontally from end to end for each run. Payment for Foundation Type III shall be made per linear foot at the price bid. This unit price shall include necessary undercut for foundation.

**J. DRIVEWAY REPAIRS & SIDEWALK REPAIR**

Repairing or replacing driveway or sidewalk surfaces constructed of concrete material shall be bid per square yard of the respective types shown on the bid form. The bid price shall include temporary planking and surfacing, preparation of the subgrade, and furnishing and installing all materials required for a permanent surface repair. Replacing damaged culverts under concrete driveways or sidewalks shall be included in the unit price per square yard for "Remove and Replace Concrete Driveway" or "Remove and Replace Sidewalk". All portions of driveways or sidewalks damaged by the Contractor that are not in the way of construction shall be repaired at the Contractor's cost.

The unit price for driveway or sidewalk repairs shall also include cutting of the driveway or sidewalk with a concrete saw so that a neat, straight joint shall be exposed after the repair is completed. The concrete finish on the driveway or sidewalk shall be as directed by the Engineer.

**K. JACKING OR BORING**

Pipe installed by the jacking or boring method shall be paid for at the contract unit price per linear foot measured from vertical cut to vertical cut for "Furnish and Install by Jacking or Boring" pipes of the various sizes and materials indicated. Such payment shall constitute full compensation for all materials, labor, equipment, tools, fittings, transportation, and supplies necessary to complete all items of the work in accordance with these specifications and applicable drawings.

In the event subsurface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks are caused on either side of the pipe line, or should the paving be otherwise disturbed or broken due to the Contractor's operation, he shall repair or replace same to its original condition or better at no additional cost to the Owner.

Where a casing is installed by the jacking or boring method, the casing shall be paid for in accordance with the method described above. The pipe installed inside the casing shall be paid for under the bid item "S.S.P." at the size and depth of cut indicated in accordance with Article 25 - Payment - Subpart B - Furnishing and Installing Sewer Lines" of this section. Bidders should establish unit prices for casings taking into consideration that pipe installed within the casing does not require excavation, backfilling, etc.

Where casing is to be installed by jacking or boring or by open trench, if the plans and specifications call for "Casing" without stipulation of material, it shall be assumed that either corrugated iron or smooth steel are acceptable. Refer to Article 2 - Materials - Subpart O - Casing of this section for material specifications.

The above described methods and stipulations shall be employed unless otherwise specified herein.

#### **L. CONNECTIONS TO EXISTING MANHOLES**

Payment for completing the necessary work for making the connections to the existing manholes at the location shown on the drawings shall be paid for per each for "Connect to Existing Manhole". Such price shall constitute full compensation for all labor, materials, supplies, equipment, and tools necessary to complete all items of the work in accordance with these specifications and plans.

#### **M. EXISTING STRUCTURES AND UTILITIES**

No separate payment shall be made for work encountered in crossing, moving, removing, and replacing, removing and disposing of stripping or exposing, and bracing or repairing the following items that fall in the path of the construction: Underground utilities, storm sewers, utility poles, fences, gates, mail boxes, guard rails, septic tanks, or any unforeseen underground obstruction. The cost of doing this work shall be included in the contract unit price for "Furnishing and Installing Sanitary Sewer Pipe".

The plans show the locations of all known surface and subsurface structures. However, the Owner and the Engineer assume no responsibility for failure to show any or all of these structures on the plans or of failure to show them in their exact location. It is mutually agreed and understood that such omissions shall not be considered sufficient cause for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever, unless the obstruction encountered requires the building of special work not provided in the plans and proposal, in which case the provisions in these specifications for extra work shall apply.

#### **N. CLEAN OUTS**

Clean outs shall be paid for at the contract unit price per each for "Clean Out" of the size stipulated in the proposal. The work as shown on the plans will involve furnishing all necessary labor, materials, equipment, tools, fittings, transportation, and supplies.

#### **O. SPECIAL BACKFILL FOR ROADWAY CROSSINGS**

Where main sewers or sewer services cross roadways or where called for on the construction drawings, special backfill requirements as set forth in Article 10 - Backfilling of this section shall be paid for at the contract unit price per cubic yard for "Special Backfill Compacted to 95% Density".

For determining backfill volume, measurements shall be made at each such crossings as follows:

##### **1. Length**

Shall be the sum of the width of the roadway plus 10' (5' on each side) unless otherwise shown on the plans. Where the angle of crossing is other than perpendicular to the roadway the length shall be measured along the centerline of the pipe for the limit of the special backfill.

##### **2. Width**

Shall be the average of the top width and bottom width of the trench. The bottom width shall not be greater than the sum of the specified pipe diameter plus 2'. The top width shall not exceed 5'.

##### **3. Depth**

Shall be the vertical distance taken at the centerline of the proposed road or existing road, as the case may be, between a point which is 12" below finished roadway grade and a point which is 12" above the top of the sewer pipe. In irregular or sloping ground, measurements shall be taken at such other points that may be required to determine a true average.

This method of measurement and payment shall be applicable wherever such special backfill is required for roadway crossings regardless of whether earth backfill or granular backfill is utilized. Payment for special backfill for roadway

crossings shall constitute full compensation for materials, equipment, tools, labor, and supervision necessary to complete the backfill in accordance with these specifications.

**P. AGGREGATE OR SHELL FOR MAINTENANCE**

Measurement of reef or clam shell for maintenance during construction or for final dress-up of streets or driveways shall be by the cubic yard, truck measurement, and placed as ordered by the Engineer. Payment for shell shall be at the unit price bid for “(Type) Aggregate for Maintenance”, or “(Type) Aggregate for Streets and Driveways” and shall constitute full compensation for furnishing, hauling, stockpiling, placing, and compacting the shell. Where the type of shell is not specified in the bid item, the contractor may use either clam shell or reef shell at his option. Where the contract does not provide a separate item for shell for streets and driveways, but does provide an item for shell for maintenance, the final dress-up of streets and driveways, shall be paid for at the contract unit price for “(Type) Aggregate for Maintenance”. The Contractor will not be paid for aggregate or clam shell used unless truck tickets are furnished to the Engineer. This payment shall be on a “one time basis” subsequent additional aggregate or shell due to subsidence of trench etc. shall be performed at no direct pay.

**Q. UNFORMED CONCRETE**

Measurement and payment for unformed concrete shall be the same as for formed concrete except no forming is required.

**R. STREET REPAIR**

Measurement of removal and replacement of asphaltic concrete streets or concrete streets shall be determined by the product of the length of the trench cutting the pavement by the width of the pavement replaced. The width for payment shall not exceed the maximum allowable top width of trench specified in Article 5 of this section plus two (2) feet.

Payment for removal and replacement of asphaltic concrete streets shall be at the unit price bid per square yard for “Remove and Replace Asphaltic Concrete Street”. Payment for removal and replacement of concrete streets shall be at the unit price bid per square yard for “Remove and Replace Concrete Street”. Payment under these items shall constitute full compensation for all materials, labor, equipment, supervision required to complete this item of work in accordance with these specifications and as shown on the plans. The unit price shall also include saw cutting of the roadway and base with a concrete saw so that a neat, straight joint shall be exposed after the repair is complete.

**S. REMOVE AND RELAY CULVERTS**

Measurement of removal and replacement of culverts shall be by the linear foot of pipe removed and reinstalled. Payment shall be at the unit price bid per linear foot for “Remove and Relay Culverts” and shall constitute full and complete compensation for furnishing all labor, equipment, joint material and incidentals necessary to complete the work.

**T. REBUILT FENCE**

Measurement of rebuilt fence shall be by the linear foot of fence removed and replaced. Payment shall be at the unit price bid per linear foot for “Rebuilt Fence” and shall constitute full and complete compensation for furnishing all labor, equipment and incidentals necessary to complete the work.

**ARTICLE 28 - TYPICAL ITEMS FOR PAYMENT**

ITEM	UNIT
(Size) (Material) S.S.P. (Cut)	Linear Foot
(Size) C.I.S.P. Material	Linear Foot
(Size) S.S.P. Service	Linear Foot
Manhole (Depth)	Each
Outside Drop to Manhole (Depth)	Each
(Size) Wye	Each
(Size) Tee	Each
(Size) Bend	Each
(Size) Service Riser (Depth)	Each
Sheathing Left-In-Place	MBFM (Thousand Board Feet)
Foundation Type III	Linear Foot
Remove and Replace Concrete Driveway	Square Yard
Furnish and Install by Jacking or Boring (Size) (Material) (Type)	Linear Foot
Connect to Existing Manhole	Each
(Size) Clean Out	Each
Special Backfill Compacted to 95% Density	Cubic Yard
(Type) Shell for Maintenance	Cubic Yard
(Type) Shell for Streets and Driveways	Cubic Yard
Formed Concrete	Cubic Yard
Unformed Concrete	Cubic Yard
Remove and Replace Asphaltic Concrete Street	Square Yard
Remove and Replace Concrete Street	Square Yard
Remove and Relay Culverts	Linear Foot
Rebuilt Fence	Linear Foot

**TECHNICAL SPECIFICATIONS  
FOR  
SANITARY SEWERAGE SYSTEMS**

**1.2 SANITARY SEWERAGE SERVICE CONNECTIONS**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all supervision, labor, tools, plant, equipment, appliances and materials required to perform and satisfactorily complete all items of work in connection with the construction of sanitary sewerage service connections.

**ARTICLE 2 - MATERIALS**

**A. 6" PVC GRAVITY SEWER SERVICE PIPE**

PVC gravity sewer service pipe and fittings for depths less than 12' shall be in accordance with ANSI/ASTM D 3034, SDR 35, 12454-B PVC cell classification in accordance with ASTM D 1784; additives and fillers shall not exceed 10 parts (by weight) per hundred of PVC resin in the compound.

PVC service pipe and fittings for depths greater than 12' shall be in accordance with ANSI/ASTM D2241, SDR 26, 12454-B PVC cell classification in accordance with ASTM D 1784. Additives and fillers shall not exceed 10 parts (by weight) per hundred of PVC resin in the compound.

Joints shall be push on type in accordance with ASTM D 3212. Flexible elastomeric seals (gaskets) shall be in accordance with ASTM F 477.

Solvent cements shall be in accordance with ASTM D 2564.

**B. AGGREGATE**

Gravel shall consist of hard, durable, siliceous particles reasonably free of sticks and other deleterious matter, and when tested in accordance with DOTD Designation TR 113, shall meet the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
1-1/2"	95 - 100
No. 4	0 - 15
Clay and Silt (DOTD TR112)	2% Maximum

Limestone shall for maintenance of existing driveways, sidewalks, etc., or for final dress-up of streets and driveways shall consist of not more than 5% foreign material by dry weight.

**ARTICLE 3 - EXCAVATION AND TRENCHING**

The Contractor shall perform all trenching with a track or rubber tire trenching machine. *Excavator equipment (backhoe) will not be permitted.* If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate or in any way change the line and profile shown on the drawings, the excavation and backfill required by said change shall be performed by the Contractor under the terms of these specifications. Any excavation beyond the authorized depths shall be filled with suitable compacted material without cost to the Owner.

All excavation shall be by open cut, except where indicated otherwise in the plans. The walls of trenches shall be kept as nearly vertical as practicable.

Trench slopes, shores, benches and/or trench boxes shall comply with the latest provisions of OSHA 29 CFR Part 1926,

Subpart P - Occupational Safety and Health Standards - Excavation.

Any water accumulated in the trenches or other excavations shall be removed by pumping or by other approved methods at no additional cost to the Owner prior to laying pipe. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the edges of the excavation to avoid overloading and to prevent slides or cave-in.

The Contractor shall control the walls of all excavated areas as is necessary to prevent movement of soil in areas supporting existing foundations, slabs, utility line poles, pipelines, or other structures. If, as a result of the excavation or through fault or neglect of the Contractor, the earth or ground under or around such foundations, slabs, utility line poles, pipelines, or other structure slips or is otherwise disturbed, corrective measures shall be taken as directed by the Engineer by and at the expense of the Contractor.

#### **ARTICLE 4 - SEWER SERVICE PIPE INSTALLATION**

The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into position and shall be kept clean during laying operations. The pipe shall not be laid when weather conditions are unsuitable for the work. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no water, earth, or other substances will enter the pipe. Any section of pipe found to be defective before or after laying shall be replaced with new pipe by and at the expense of the Contractor. The Contractor shall supply the necessary equipment to maintain and check a minimum 1% slope on the pipe. The bottom of the trench shall be accurately graded to provide uniform bearing and support for the full bottom segment of the pipe for its entire length. This segment, as a minimum, shall be equal to 4/10 of the outside diameter of the pipe. Bell or coupling holes shall be carefully excavated at proper intervals so that no part of the load is supported by the bells or couplings. All grading shall be hand shaped, using the natural material in the bottom of the trench or, if directed by the Engineer, a bedding of aggregate.

Walking or working on the completed sewer pipe, except as may be necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to a height of at least one (1) foot above the top of the pipe.

As soon as each length of pipe has been properly placed and jointed, the spaces between the pipe and sides of the trench shall be carefully backfilled with earth, no particle of which shall be larger than will pass through a one (1) inch ring. The backfill shall be compacted as specified in this section of these specifications.

It is the duty of the Contractor to investigate the subsurface conditions prior to submitting a bid. No sewer pipe shall be placed in a wet trench or on an unstable trench bottom.

Sanitary sewer services crossing existing roadways shall be installed by means of "Jacking or Boring".

#### **ARTICLE 5 - SEWER SERVICE PIPE CONNECTIONS**

All PVC joints shall be assembled making certain the bell is clean and the spigot end is free of all foreign matter. The dimension of fittings and joints shall be compatible with the pipe and measured in accordance with ASTM D2122. Joints and fittings shall be as uniform as commercially practicable in color, opaqueness, density, and other specified physical properties and free from visible cracks, holes, foreign inclusions, or other defects.

Joints and fittings shall conform to the requirements of the applicable specifications referenced in the ASTM or AWWA specifications for the pipe and the requirements shown on the drawings.

Rubber gaskets for pipe joints shall conform to the requirements of ASTM F477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Clay, ABS plastic, cast or ductile iron pipe shall be connected to PVC pipe using required Fernco flexible couplings and stainless steel worm drive hose clamps where shown on the plans.

**ARTICLE 6 - BACKFILLING**

As soon as the joints have been completed and approved by the Engineer, the space around the pipe shall be filled with acceptable material, free from attached stones, hard clay lumps, or other hard substances. Care should be exercised in placing backfill about the haunches of the pipe to avoid displacement.

The remainder of the backfill above the pipe area shall contain no stumps or roots and shall be free of lumber, trash or other debris. The backfill shall be allowed to settle for a sufficient amount of time before final dress-up and driveways and sidewalks are repaired.

**ARTICLE 7 - UNDERGROUND UTILITIES**

It shall be the responsibility of the Contractor to exercise the utmost care in locating the existing underground utilities as accurately as possible, ahead of the actual construction work. In the event that construction operations are to be done in the vicinity of underground utility lines as shown on the drawings, the Contractor shall immediately notify the Engineer and a representative of the respective companies prior to doing any work in the area. This notification shall be given at least one week in advance of the proposed construction to avoid any delay in operations. All excavation shall be done by hand in the immediate vicinity of underground utility lines.

The Contractor shall be responsible for any damages to utilities or utility structures that may result through his construction operations at no cost to the Owner, whether said utilities are indicated on the plans or not.

**ARTICLE 8 - PROTECTION AND CARE OF PUBLIC OR PRIVATE PROPERTY AND EASEMENTS**

The Contractor shall conduct his operations in such a manner so that interference with public travel and inconvenience to the public and to property owners will be minimized. Operations shall be so conducted as to cause minimum interference with access to the property. Twenty-four hour notice to owners of private driveways shall be given prior to interfering with driveways.

The Contractor shall continuously maintain and protect all underground and above ground structures, utilities, including the restoration of all public utilities, water mains, water services, gas mains, gas services, culverts, drains, ditches, curbs, sidewalks, landscaping and/or other facilities which may be damaged, to a condition at least equal to their original status, at no additional cost to the Owner. In the event of damage to any facilities, the appropriate utility will be notified immediately.

The Owner will repair damaged facilities at the Contractor's expense or require the Contractor to repair said damage.

All work shall be accomplished so as to cause the least amount of disturbance and a minimum amount of damage. The Contractor shall schedule his work so that trenches across easements shall not be left open for more than 48 hours.

Prior to excavation on an easement or private right-of-way, and where required by the Engineer, the Contractor shall strip top soil from the trench or construction area and stockpile it in such a manner that it may be replaced by him, upon completion of construction. No trees or shrubbery shall be removed or trimmed without consent of the Engineer. Ornamental trees and shrubbery shall be carefully removed, with the earth surrounding their roots wrapped in burlap and replaced in their original positions within 48 hours. All shrubbery or trees destroyed or damaged shall be replaced by the Contractor with material of equal quality at no additional cost to the Owner.

The Contractor shall notify the Engineer and property owner at least 24 hours in advance of any work done on easements, rights-of-way, or private property.

It is expressly understood that the Contractor shall restore all private property affected by his work to a condition equal to their original condition, and in a condition satisfactory to the property owners and the Engineer.

The Contractor shall maintain adequate drainage during the process of construction. Performance of this work is not payable directly, but shall be considered as a subsidiary obligation of the Contractor, covered under the contract price for the construction items.

**ARTICLE 9 - JACKING OR BORING**

Install pipe by means of a boring machine, auger, jack, or by other means satisfactory to the Engineer.

In the event the jacking or boring operations result in injury or damage to railroad tracks or pavements, repairs shall be the responsibility of the Contractor and shall be done at no additional cost.

Any overcutting of the borehole shall be remedied by pressure grouting the entire length of the installation. Backfill boring pits to the bottom of the pipe with limestone at no additional cost.

Schedule jacking or boring operations such that no pits shall be left open at the end of the day.

Adequate sheathing and bracing shall be provided to prevent earth slides or cave-ins. Trench slopes, shores, benches, and/or trench boxes shall comply with the latest provisions of OSHA 29 CFR 1926 - Subpart P, Occupational Safety and Health Standards - Excavations.

**ARTICLE 10 - MEASUREMENT AND PAYMENT****A. GENERAL**

No separate payment will be made for "Excavation and Trenching", "Backfilling", or "Protection of Public or Private Property and Easements" and all cost in connection therewith shall be considered incidental to and included in the contract unit price for furnishing and installing sewer service lines unless a separate item is provided in the Contract Proposal.

**B. FURNISHING AND INSTALLING SEWER SERVICE LINES**

Payment for furnishing and installing sewer service lines shall be based on the actual number of linear feet installed, measured horizontally from connection at existing sewer main to connection at the house plumbing system. No deductions from lengths so determined shall be made for sewer fittings. Fittings will be furnished and installed at no direct pay.

**C. DRIVEWAY REPAIRS**

Repairing or replacing driveways or sidewalk surfaces constructed of concrete material shall be bid per square yard of the respective types shown on the bid form. The bid price shall include temporary planking and surfacing, preparation of the subgrade, and furnishing and installing all materials required for a permanent surface repair. Replacing damaged culverts under concrete driveways or sidewalks shall be included in the unit price per square yard for "Remove and Replace Concrete Driveway". All portions of driveways or sidewalks damaged by the Contractor that are not in the way of construction shall be repaired at the Contractor's cost.

The unit price for driveway or sidewalk repairs shall also include a perpendicular cut of the driveway or sidewalk with a concrete saw so that a neat, straight joint shall be exposed after the repair is completed. The concrete finish on the driveway or sidewalk shall be as directed by the Engineer.

**D. EXISTING STRUCTURES AND UTILITIES**

No separate payment shall be made for work encountered in crossing, moving, removing and replacing, removing and disposing of, stripping or exposing, and bracing or repairing the following items that fall in the path of the construction: underground utilities, storm sewers, utility poles, fences, gates, mail boxes, guard rails, septic tanks, or any unforeseen underground obstruction. The cost of doing this work shall be included in the contract unit price for furnishing and installing "Sanitary Sewer Service Pipe".

**E. CLEAN OUTS**

Clean outs shall be paid for at the contract unit price per each for "Clean Out" of the size stipulated in the proposal. The work as shown on the plans will involve furnishing all necessary labor, materials, equipment, tools, fittings, transportation, and supplies. The contractor shall be aware that all cleanout plugs shall be brass and shall be paid for under the bid item "Furnish & Install Clean Out" of the size stipulated in the proposal.

**F. AGGREGATE OR CLAM SHELL FOR DRIVEWAYS AND SIDEWALKS**

Measurement of gravel or clam shell for maintenance during construction or for final dress-up of streets or driveways shall be by the cubic yard, truck measurement, and places as ordered by the Engineer. Payment for shell shall be at the unit price for “(Type) Aggregate for Maintenance”, or “(Type) Aggregate for Streets and Driveways” and shall constitute full compensation for furnishing, hauling, stockpiling, placing and compacting the shell. Where the type of shell is not specified in the bid item, the Contractor may use either clam shell or reef shell at his option. Where the contract does not provide a separate item for shell for streets and driveways, but does provide an item for shell for maintenance, the final dress-up of streets and driveways shall be paid for at the contract unit price for “(Type) Aggregate for Maintenance”. The Contractor will not be paid for aggregate or clam shell used unless truck tickets are furnished to the Engineer. This payment shall be on a “one time basis” subsequent additional aggregate or shell due to subsidence of trench etc. shall be performed at no direct pay.

**G. JACKING OR BORING**

Pipe installed by the jacking or boring method shall be paid for at the contract unit price per linear foot measured from vertical cut to vertical cut for “Jacking or Boring” pipes of the various sizes and materials indicated. Such payment shall constitute full compensation for all materials, labor, equipment, tools, fittings, transportation, and supplies necessary to complete all items of the work in accordance with these specifications and applicable drawings.

In the event subsurface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks are caused on either side of the pipe line, or should the paving be otherwise disturbed or broken due to the Contractor’s operation, he shall repair or replace same to its original condition or better at no additional cost to the Owner.

Where a casing is installed by the jacking or boring method, the casing shall be paid for in accordance with the method described above. The pipe installed inside the casing shall be paid for under the bid item “S.S.P. Service” at the size indicated in the contract proposal. Bidders should establish unit prices for casings taking into consideration that pipe installed within the casing does not require excavation, backfilling, etc.

Where casing is to be installed by jacking or boring or by open trench, if the plans and specifications call for “Casing” without stipulation of material, it shall be assumed that either corrugated iron or smooth steel are acceptable. Refer to Section III-1.1 Article 2 - Materials - Subpart O - Casing of this section for material specifications.

The above described methods and stipulations shall be employed unless otherwise specified herein.

**H. CONNECT TO EXISTING HOUSE PLUMBING**

Payment for completing the necessary work for making the connection to the existing house plumbing shall be paid for per each for “Connect to Existing House Plumbing”. Such price shall constitute full compensation for supplying all necessary labor and materials, including the fittings, to connect the existing house plumbing system to the new sanitary sewer service line and to disconnect and plug the existing plumbing from the house to the existing septic tank as shown on the detail sheet in the plans.

**I. CONNECT TO EXISTING 6" SEWER SERVICE**

Payment for completing the necessary work for making the connection to the existing 6" sewer service shall be paid for per each for “Connect to Existing 6" Sewer Service”. Such price shall constitute full compensation for supplying all the necessary labor and materials, including all fittings to connect the new sanitary sewer service line to the existing 6" sewer service as shown on the detail sheet in the plans.

**J. PLUG EXISTING SEWER SERVICE (4" or 6")**

The contractor shall be aware that all abandoned sewer services shall be plugged as detailed in the construction plans. Payment for this item shall be paid for under bid item “Plug Existing Sewer Service (4" or 6")”, and such payment also shall include all labor, tools, material, supervision, and necessary to complete the work.

**TECHNICAL SPECIFICATIONS  
FOR  
WASTEWATER LIFT STATIONS**

**2.4 SUBMERSIBLE SEWAGE PUMP STATION**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all labor, plant, equipment, appliances and materials for installing an automatic, submersible type sanitary sewage pumping station, complete with all necessary accessories, controls and equipment.

The station shall be installed in accordance with the contract drawings and the installation instructions of the manufacturers.

**ARTICLE 2 - GENERAL NOTE**

Be aware that certain areas of the pump station are considered Class I, Division I, Group C and D "hazardous" areas, as defined in Articles 500 and 501 in the National Electrical Code. Special wiring techniques, materials, and equipment must be used in such areas. All equipment used in hazardous areas must be suitable for use in such areas.

All equipment shall be designed and arranged to comply fully with provisions of NFPA 820, "Fire Protection in Wastewater Treatment and Collection Facilities", relative to hazardous environments. All wiring methods, enclosures, options and accessories required to comply fully with NFPA 820 shall be included in the bid.

In order to ensure equipment compatibility one supplier shall be responsible for providing all wastewater pumping equipment, including pump, motor, bases, guides, and control panels.

**ARTICLE 3 - PUMP DESIGN**

The Contractor shall furnish and install a minimum of two submersible, non-clog sewage pumps, each capable of delivering the design flow at the operating conditions shown on the plans.

Each pump shall be equipped with a submersible electric motor connected for operation on the type service shown on the electrical riser diagram. Motors shall not be overloaded at the design conditions nor at any head in the operating range of the pumps.

Each pump shall be capable of handling raw, unscreened sewage. All openings and passages shall be large enough to permit the passage of a sphere 3.0" in diameter and any trash or stringy material which can pass through a 4.0" house collection system.

**ARTICLE 4 - PUMP CONSTRUCTION**

The pumps shall be fitted with impellers of the non-clog design, constructed of a material suitable for continuous submergence in raw sewage. The impeller shall be a closed, single or two vane type, capable of passing 3" solids and easily removable. Pump casings shall be fitted with a wear-ring system that will provide efficient sealing between the volute and impeller. Pump impellers shall be easily removable.

The pump shafts shall be of high-grade alloy steel, accurately machined and ground to exact size, and shall be isolated from the pumped liquid. Double mechanical pump shaft seals shall be provided to prevent leakage. The seals shall not require maintenance nor adjustment. However, the seals shall be easily inspected and replaceable. The shaft sealing system shall be capable of operating submerged to depths of, or pressures equivalent to 50.0'. No seal damage shall result from operating the pumping unit out of its liquid environment. The seals shall be lubricated from an oil chamber. The seal system shall not rely upon the pumped media for lubrication.

Pump fasteners shall be of 303 stainless steel or better.

**ARTICLE 5 - MOTORS**

Pump motors shall be of the sealed submersible type, having a nameplate rating that exceeds the maximum horsepower required by the pumps. Motors shall be sized in accordance with NEMA design Class B, and incorporate Class F insulation materials to withstand a continuous operating temperature of 155° C (311° F). All pump motors shall be designed for continuous duty and shall be non-over loading over the full range of the pump curve. Motors shall be capable of sustaining a maximum of 15 starts per hour. Lubrication and cooling systems, double mechanical seals, double sealed roller bearings, and other components shall be adequately designed for the stated operating conditions.

Motors and pumps shall be capable of unsubmerged operation (in air) for a minimum period of at least one (1) hour without damage to the units.

Motors shall be provided with thermal overload protection and two moisture detection sensors. The moisture detection sensors shall be wired internally to the control cable at the top of the motor.

Comply with the National Electrical Code (NEC) requirements for Class 1, Group C and Division D, Division 1 locations.

**ARTICLE 6 - MOTOR CABLE**

The special pump motor multi-conductor cable shall be suitable for submersible pump application and shall comply with the National Electrical Code (NEC) requirements for Class I, Division I Hazardous (Classified) Locations. This shall be indicated by a code or legend permanently embossed on the cable. The flexible cable shall be of a type listed for extra-hard usage. It shall contain grounding conductor having a continuous identifying marker readily distinguishing it from other conductors (i.e., motor phase conductors, seal failure probe conductor, over temperature conductors) in an approved manner. Cable shall be connected to terminals of supply conductors in an approved manner and be sized according to NEC ampacity tables (for 125% of load). Cable shall be supported by clamps or other suitable means that will prevent tension on the terminal connections. Cable shall be provided with suitable CG hub-type seals where the flexible cord leaves the wet well conduit and where it enters the intermediate junction box. The flexible cable must be removable without entering the wet well. The cable entry water seal design shall be such that precludes specific torque requirements to insure a watertight and submersible seal. Epoxies, silicones, or other secondary sealing systems shall not be required or used. The cable entry junction box and motor shall be separated by a sealing device which shall isolate the motor interior from foreign materials gaining access through the pump top.

**ARTICLE 7 - PUMP REMOVAL**

Pumps shall be readily removable and replaceable without need for dewatering the wet well or workmen entering the wet well. Accessories required for this function include, but are not limited to the following:

**A. PUMP MOUNTING BASE**

A separate mounting plate shall be furnished for each pump. These plates shall include adjustable guide rail supports and discharge elbow with flange to align with pump hydraulic sealing flange. The discharge base elbow shall be furnished by the pump manufacturer. The discharge elbow shall have a foot for anchoring to the wet well floor and a means for firmly supporting the guide rails. Contractor shall verify location of anchor bolts prior to pouring wet well base. The design and mass of the discharge elbow shall be sufficient for rigidly supporting the eccentric load of the pump unit and discharge piping. The discharge of each pump shall be fitted with a hydraulically operated sealing flange. When the pump is in operation, pressure shall provide a leak proof seal. When pump is idle, pressure shall be removed so that pump can be removed from sump with no mechanical contact of sealing flanges. Complete weight of pump to rest on bottom support plat, no weight to be supported on guide rails or discharge elbow. The discharge elbow outlet shall connect to the discharge piping riser. The elbow outlet shall have ANSI, 125.0 pound flange dimensions and drilling, of the size indicated on the construction drawings. Plates and fittings shall be cast iron with stainless steel hardware.

**B. GUIDE BRACKET**

A sliding guide bracket shall be an integral part of the pump unit. The design of the bracket shall obtain a pure vertical shearing action at the pump to discharge flange face when connecting or disconnecting to pump to the discharge elbow. The bracket design shall obtain a wedging action at the flange faces as the final alignment of pump to piping occurs.

**C. GUIDE RAILS**

Each pumping unit support shall be equipped with a stainless steel dual guide rail system sized to fit the discharge elbow and guide bracket, as recommended by the manufacturer's specifications. The dual guide rails shall extend from the pump to the access frame at the top of the wet well. Intermediate stainless steel supports shall be installed to stiffen the pump rails per manufacturer's recommendation (at a maximum of 10 foot intervals). Supports shall be secured to the wet well wall utilizing type 316 stainless steel wedge anchors.

**D. ACCESS FRAME AND COVERS**

A single or double door access frame assembly shall be installed at the top of the wet well in the precast concrete cover capable of supporting a live load of 300 pounds per square foot. Double door access frame assembly shall be required on wet wells with an internal diameter of greater than 72". The assembly shall be aluminum with type 316 stainless steel hardware. The frame shall be bituminous coated where it will contact concrete.

The wet well access hatch shall be fitted with a hinged grating panel to provide a system for fall protection. The safety system shall be manufactured by Halliday Products, or approved equal.

The access frame assembly shall accommodate both pumps, with upper guide bearing brackets, a stainless steel safety chain hook, hinged and hasped covers, stainless steel level sensor cable holders and cable holder, as required, automatic lock when opened 90 degrees, and shall be lockable. Cable holder shall be clear of the pump guide system and discharge piping (gravity and/or force main), and the beam path of the ultra-sonic transducer. Cables shall be supported on the cable hanger by stainless steel cable grips. Cable holder shall be readily accessible from the access hatch.

The valve pit access frame assembly shall be of the same materials and construction as for the wet well access frame assembly.

**E. LIFTING CHAIN**

A stainless steel cable/chain, sized by the pump manufacturer for installing and removing the pump unit without failure, shall be furnished with each pump. Provide a means for attaching the other end of the cable/chain to the wet well access frame assembly.

**ARTICLE 8 - CONTROLS**

A complete system shall be furnished to control the liquid level in the wet well as specified in this article except as modified by Section III-7 for the specific conditions in this project. The unit shall include an alternator or pump controller (see plans), to alternate the starting sequence of Pumps Number 1 and Number 2 (starting the first pump as a "Lead" pump) – in addition, the controls shall be able to operate the pumps singly, either automatically or manually. Should either pump, operate alone, fail to run, the other pump shall start. Should the first pump fail to lower the level, then the other pump shall operate and run as a "Lag" pump. Control sequence shall be as indicated on construction drawings.

Across the line magnetic starters with phase failure protection (except for single phase motors) and thermomagnetic circuit breakers shall be provided for each pump, hand-off-automatic selector switch for each starter, with overload relay and reset button. Adequate number of circuit breakers and receptacles and at least one spare circuit shall be provided to operate sewage pump station and provide for lighting and receptacles.

To control the operation of the pumps with variations of sewage level in the wet well, tip float level sensors shall be provided. No mercury switches will be acceptable. The contact closure shall be dry for "C" contacts (both a n/o & n/c with a common). The floats and cable shall be made of material that will withstand raw sewage. Cables shall be a minimum 40 feet in length. Tip float switches shall be the Consolidated Electric's Direct Acting Model 9G-EF (EF=Environmentally Friendly) Float Switch (or pre/prior approved equal) Teflon coated 316 SS with PVC jacketed cable that resist build up of solids.

One float switch shall act as a Low Water Cut Off (LWCO) and another shall act as a High Level indicator. In addition, these two float switches shall act as emergency pump start/stop switches in the event of a control failure.

In addition to controlling the operation of the pumps, the level control switches shall actuate the station indicator pilot lights, red and green, as shown on the construction plans. The red light is a high wet well level alarm indicator.

An automatic alternator with manual on-off switch shall be provided to change the sequence of operation of the pumps on the completion of each pumping cycle.

Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low level pump.

Additional controls to be provided are as follows:

- a. Heat sensing units attached to motor winding to trip starter if motor overheats.
- b. Motor seal failure alarm light to indicate water in seal chamber.
- c. Pump running time meters.
- d. Delayed motor start to prevent both pumps starting simultaneously after a power outage.
- e. Starting capacitors shall be provided if required and shown on the plans.

The Contractor shall furnish a 7.5-kVA, 240/120-V, single-phase transformer to provide control circuit power from a 480-V service.

The control equipment shall be mounted in a NEMA Type 4X aluminum or stainless steel, weatherproof and tamper proof enclosure. The circuit breakers, overload reset buttons, and control switches shall be operable from an inner door.

The control enclosure and all internally mounted equipment and material shall be designed and manufactured by the pump supplier.

The control panel shall be mounted on a rack per the electrical drawings.

The contractor shall furnish a 100A (or if required by the motor power requirements, a 200-A service duty double throw switch (On-Off-On) for routing power from either the utility service or the generator service receptacle. The generator receptacle, mounted on the underside of the double throw switch enclosure, shall be rated at either 100-A or 200-A, depending on the motor power requirements.

#### **ARTICLE 9 - ELECTRICAL**

The electrical system shall be installed as shown on the plans, and as required in these specifications and shall conform to the requirements of the National Electrical Code (latest edition) for a Class I, Division I location, the applicable local codes, and the rules and regulations of the local utility. For the specific electrical work required in this contract, the Contractor shall refer to Section III-7 or the Electrical Section of the Project Specifications which shall govern over the general requirements of this article.

The electrical service specified on the electrical riser diagram shall be provided up to the sewage pump station control panel as part of this contract, as well as conduit connections and conductor connections to the control panel.

It is to be expressly noted that the Contractor shall furnish and install all electrical wiring, fixtures, and connections required for the complete hook-up of the pump station, including conduit, conductors, bulbs, etc., as required.

All wiring in the pump station shall be color coded as indicated on the wiring diagram. Wiring diagrams matching the unit wiring shall be provided to the Owner.

#### **ARTICLE 10 - PUMP STATION AND WET WELL**

The Contractor shall construct the wet well of the size and type indicated on the construction drawings. Materials used shall be in accordance with these specifications and shall be furnished by the Contractor. Necessary connections and access openings shall be installed.

Pipe and fittings for station hook-up shall be flanged pipe meeting all requirements of ANSI A21.51 (AWWA C151) and ANSI A21.15 (AWWA C115) with a maximum working pressure of 250 psi, and rubber gaskets complying with ANSI A21.11 (AWWA C111). Pipe shall be furnished with ductile iron flanges screwed on and drilled and faced in accordance with ANSI B16.1, Class 125, unless otherwise noted. Pipe shall be standard cement lined and seal coated with an approximate bituminous coated outside in accordance with ANSI Specification A21.4 (AWWA C104), latest revision. Outside bituminous coating shall be omitted on all exposed pipe to be painted. Valves, fittings, and other required materials

shall be in accordance with these specifications as set forth in the following article.

#### **ARTICLE 11 - MATERIALS**

##### **A. WET WELL AND VALVE PIT**

Concrete pipe used for the wet well and outside valve box shall be standard strength reinforced concrete pipe conforming with all requirements of the "Standard Specifications for Reinforced Concrete Culvert Pipe", ASTM Designation C-76 for Class III, Wall B. Circular reinforcement shall be utilized, ASTM 615, Grade 60.

All concrete pipe joints shall be made water tight by using a profile gasket for single step joints. Profile gasket shall be Type 288-4G as manufactured by Press-Seal Gasket Corporation or preapproved equal.

All penetrations of the concrete pipe shall be cast-in-place or cored. Electrical conduit shall extend 4" within the inside wall. The electrical conduit risers through which the submersible pump cables pass shall extend 18 inches above the top of the wet well cover.

Water tight connectors shall be shall be ASTM C 923, KOR-N-Seal, flexible watertight connectors as manufactured by NPL Systems, Inc. or approved equal.

Provide Class A concrete under the provisions of DOTD Standard Specification 901.

Grout shall be one part portland cement, and two parts mortar sand, and water as required for proper consistency; to be used within 30 minutes of mixing.

##### **B. STRUCTURAL CONCRETE**

Concrete used in construction of the foundations shall have a minimum compressive strength of 4,000 PSI at 28 days when tested in accordance with AASHO Designation T22.

Forms for concrete structures shall be designed and built so as to be mortar-tight, sufficiently rigid to prevent pressure distortion, and capable of being removed without injuring the concrete. Forms shall not be removed until the concrete has obtained sufficient strength to support the load imposed.

Steel reinforcing bars shall be new billet stock, Grade 60 conforming to ASTM Specification A-615 and deformed to conform to ASTM Specification A-305. Splicing of bars will not be permitted without approval of the Engineer. Bent bar reinforcement shall be cold bent to the shapes shown on the plans. All bends shall be made around a pin having a diameter not less than six times the minimum thickness of the bar. All reinforcement shall be free from loose rust scale or other coatings that will destroy or reduce the bond. All reinforcement shall be inspected and approved by the Engineer before placing concrete.

Curing of the finished concrete surfaces shall be by covering within 12 hours with canvas, burlap, straw, or sand, which shall be kept wet by sprinkling for at least three days.

Completed concrete that will be left exposed shall be finished by rubbing exposed surfaces with carborundum or other abrasive to a smooth surface and to the removal of all form marks. Non-exposed surfaces shall have the form finish, except that all defects and holes shall be corrected. All edges or corners shall be chamfered as indicated on the plans or as directed by the Engineer.

**C. AGGERATE****Limestone**

Limestone shall consist of 100% crushed limestone aggregate and shall show not more than 45% loss when tested in accordance with AASHTO Designation: T 96 and shall show not more than 15% loss when tested in accordance with AASHTO Designation: T 104 and shall be graded as follows:

<b>STONE</b>	
<b>U.S. SIEVE</b>	<b>PERCENT PASSING (BY WEIGHT)</b>
1-1/2"	100%
1"	90 - 100
3/4"	70-100
Number 4	35-65
Number 40	12 – 32
Number 200	5 – 12

The fraction of the stone passing the No. 40 sieve shall be non-plastic.

Location and thickness to be as shown on the plans.

**D. VALVES AND FITTINGS**

The gate valves over 2.0" shall conform to the latest edition of AWWA Specification C509, and shall have non-rising stem, iron body, iron wedge encapsulated with molded rubber and "O"- ring seals, Mueller 2360 Series Resilient Wedge Gate Valve, Catalogue No. 2360-6 Flange Ends, or equal.

The gates valves 2.0" and under shall be bronze, rising stem, double disk with screwed ends (Crane Bronze Gate Valve, Class 150, Rising Stem, Threaded Ends, Figure 4310B, or equal). All gate valves shall be furnished with operating hand wheels.

The check valves shall be iron body, bronze mounted, swing type spring and lever check valves with flanged ends, Mueller Catalogue No. A-2602-6-02, or approved equal. Check valves shall comply with AWWA C508.

Check valves 2" and under shall be bronze, swing type spring and lever check valves with screw ends (Crane 1700 Series Bronze Check Valves, Class 125, Threaded Ends, Figure 1707, or approved equal).

Flanged fittings shall conform to ANSI A21.10 (AWWA C110). Bolt circle and bolt holes of flanges on ductile iron fittings shall match those of Class 125 flanges shown in ANSI B 16.1 and can be joined to Class 125, ANSI B 16.1. Gaskets for all flanged joints shall be full-faced, 1/8" solid rubber, or approved equal. Fittings shall be bituminous coated outside and cement lined to a standard thickness and seal coated inside in accordance with ANSI Specifications A21.4 (AWWA C104). Outside bituminous coating shall be omitted on all exposed pipe to be painted. Bolts and nuts on connections within the wet well shall be type 316 stainless steel.

Measuring and sensing devices shall require a ball valve with brass body and stainless steel ball.

**E. MISCELLANEOUS**

The discharge of both pumps shall be equipped with 4" diameter dial pressure gauges with shut-off valves. Pressure gauges shall be as manufactured by Tel-Tru Manufacturing Company, Model 30 or approved equal. Pressure gauges shall range from 0 – 60 psi. Each gauge shall be equipped with a diaphragm seal protector as manufactured by Tel-Tru Manufacturing, Model M-Mini seal for up to 4 1/2" Gauges or approved equal. Gauges shall be glycerin filled. All components of the gauge shall be non-corrosive (i.e. stainless steel or other acceptable nonferrous material).

Unless otherwise noted in these specifications and/or on the construction drawings, all assembly and anchor bolts, nuts, and washers shall be stainless steel. Bolts and nuts shall conform to ASTM A276, Type 316. Washers shall conform to ASTM A666 Type 316.

All hardware and appurtenances shall be a minimum type 316 stainless steel unless a higher grade is called out.

Stainless steel fabrications to be in accordance with ASTM specifications applicable to the type of component or hardware.

Provide Reliner modular inside drop system with stainless steel straps by Duran, Inc. (800-504-8008) or approved equal. The bowl size shall be determined considering the incoming pipe diameter at full flow in accordance with the manufacture's recommendations.

A four-inch aluminum quick-connect shall be installed in the valve box (Cam-locks Type F or approved equal). The Cam shall be fitted with a Camlock dust cover.

The contractor shall furnish and install a water service to the lift station site, with a backflow preventer and hose bib as per the construction plans. The contractor is responsible for and fees associated with the installation of this water service.

## F. PAINTING

### A. Piping and Fastening Appurtenances.

- a. Piping and fastening appurtenances shall be coated with Carboline 187 Epoxy Phenolic System or an approved equal. Carboline 187 Epoxy Phenolic System shall consist of two (2) coats, 5.0 – 6.0 mils DFT each. The first coat shall be Red color number 274-0500 and the finish /topcoat color shall be Gray color number 274-C703
- b. A "Stripe Coat" shall be applied to all flanges, appendages, etc. during the application of both coats. In the event of a spray application (preferred), a "stripe coat" is defined as an application of the given coating material to all edges, seams and other difficult to reach, see or hard to coat surfaces. These areas shall be given special attention (even by brush/roller application if needed), thinned as necessary to insure adequate mils DFT are applied. Immediately after the application of the said stripe coat, the full and overall application of the given coat is then applied, i.e. in a wet-to-wet mode.
- c. The pipe shall be clean, dry and decontaminated prior to abrasive blasting. Surfaces to be coated shall be cleaned per SSPC-SP1. Following this process, the surfaces shall be abrasive blasted to meet SSPC-SP5 cleanliness standard to obtain a 1.5 – 3.0 mil anchor profile.
- d. Field touchup of pipe coating:
  - i. All shop coats shall be touched-up and completed at welds or joints after field erection. Surfaces shall be properly prepared per the following procedure for all field repairs of welds and coating system damages:
    - Clean, dry and decontaminate the surfaces to be repaired per SSPCSP1.
    - Clean surfaces per SSPC-SP2 and/or SSPC-SP3 – Hand/Power Tool Cleaning as needed.
    - All edges of existing, tightly adhered coatings shall be feather edged to provide a beveled/smooth transition configuration for the coating to be applied. All discolored coatings surrounding weld burns shall be removed to a point where the existing coating are sound (typically 1" – 2" from the weld seam).
    - Apply a coat of Carboline's Carbomastic 15 (or Carbomastic 15 FC for temperatures below approximately 80 deg. F) to obtain 6.0 – 8.0 mil DFT.
    - Apply a finish/topcoat of Carboline's Phenoline 187 Finish Topcoat color Gray number 274—C703.
    - All priming and finish/topcoat shall be applied as per manufacture's Product Data Sheet (PDS).

**ARTICLE 12 - EXCAVATION, BACKFILL, AND GRADING**

The Contractor shall excavate to the depths required to install the structures in accordance with the drawings, keeping the limits of excavation to within 2.0' of the neat lines of foundations wherever possible. Excavation beyond the required depths and widths shall be filled with suitable materials at no extra cost to the Owner.

Excavated material shall be stockpiled for use in backfilling. It shall be placed a safe distance from the excavation without overloading the undisturbed soil.

The excavation shall be accomplished in a manner to protect adjacent structures and to safeguard workmen. It shall be the responsibility of the Contractor to install underpinning, shoring, sheeting or other protection where needed to protect facilities and workmen. All existing structures, pipes and foundations which are to be incorporated into the final work shall be adequately protected or shall be replaced by the Contractor.

Surface water shall be directed from the excavation by grading and/or constructing ditches or berms.

The Contractor shall submit his proposed excavation plan to the Engineer in writing before commencement of the work. The method of construction adopted shall be subject to approval of the Engineer, but such approval shall not relieve the Contractor of his responsibility for the safety and adequacy of his construction procedures.

Prior to placing backfill, all trash, debris and timber shall be removed from the trench or excavation. The backfill shall be made from suitable materials.

Backfill shall be placed in layers not to exceed 8.0" in depth and shall be compacted by mechanical tamping or rolling, or by other methods proposed in writing by the Contractor and approved by the Engineer. Fill shall be compacted to 90% maximum density in accordance with ASTM 1577 (modified proctor) to a depth of 3.0' below grade. Fill above this point shall be compacted to 95% maximum density in accordance with ASTM 1577 (modified proctor).

Final lift station slab elevation shall be one foot (1') above the 100 year flood elevation. Fill material and grading of the site as shown on the plans shall be included as lump sum payment for the pump station.

All affected areas of the project site shall be graded to the elevations, contours, and shapes as required on the drawings. All roots, trash, and debris shall be removed. The earth shall be finished to be free of humps, ridges, and depressions.

Sand shall not be used as backfill material for any excavations within the project site.

**ARTICLE 13-WET WELL AND VALVE BOX INSTALLATION**

Excavate to depths required to install the structures in accordance with the Drawings. Maintain limits of excavation to 3 feet of the lines of foundations as much as possible.

Holes shall be predrilled in wet well and valve box to receive watertight connectors at influent lines.

Provide foundation bedding as indicated on the Drawings.

Erect wet well precast pipe sections with watertight joints as indicated in the Drawings.

Access frames and covers shall be installed in the pre-cast concrete top, assuring correct orientation and location with regard to hinges, direction of opening, components, and accessories.

**ARTICLE 14-PUMPS, PIPING, VALVES AND ACCESSORIES INTALLATION**

Attach the upper guide brackets to the access frame.

Install anchor bolts, nuts, and washers for mounting pump base to wet well floor in accordance with pump manufacturer's instructions.

Position pump mounting base and discharge elbow on the floor on the wet well.

Install guide rails between upper guide brackets and discharge elbow with intermediate brackets.

Insure guide system is properly aligned and level and anchored according to manufacturer's instructions.

While pumps are being lowered onto the guide rail system, a check shall be made between the volute flange and discharge elbow flange.

After the pump base is grouted into place, install all piping in accordance with manufacturer's instructions and the Drawings.

Install pressure gauges on discharge piping at the location as indicated in the Drawings.

Install inside drop system as per manufacturer's instructions.

#### **ARTICLE 15 – WET WELL TIGHTNESS TESTING**

Prior to backfilling wet well, a hydrostatic test shall be performed on the wet well structure in accordance with ACI 350.1R-01.

#### **ARTICLE 16 - FENCE AND DRIVEWAY**

The Contractor shall furnish and install a 6.0' chain link fence unless otherwise noted on construction plans around the perimeter of the pump station site in accordance with the details shown on the construction drawings.

Chain link fabric shall be either aluminum coated conforming to the requirements of ASTM-A491-74 or galvanized conforming to the requirements of ASTM-A392-74, Class 2 coating. Fabric shall be woven from 9-gauge (coated size) wire in a 2.0" mesh. Fabric shall be knuckled at one selvage and twisted and barbed at the other selvage.

Posts and rails shall be roll formed, open seam, self-draining shaped hot-dip galvanized in conformance with the requirements of ASTM-A123-73 or galvanized standard weight pipe conforming to the requirements of ASTM-A120-73.

Line posts shall be C-Section roll formed from steel conforming to ASTM-A570-72, Grade E, 2.25" x 1.70" with minimum bending strength of 316 pounds under a 6.0' cantilever load, or 2-3/8" OD standard weight galvanized pipe with minimum bending strength of 201 pounds under a 6.0' cantilever load.

Top and brace rails shall be roll formed section of 1.625" x 1.25" channel shaped rail with minimum vertical bending strength of 192.0 pounds on 10.0' span or 1.66" OD standard weight galvanized pipe with minimum vertical bending strength of 202.0 pounds on 10.0' span. Top rail couplings 6.0" minimum in length shall be spaced at maximum 21.0' centers and 9.0-gauge minimum fabric tie wires shall be spaced at 24.0" maximum centers.

All end, corner, and pull posts and gates posts for gate leaves 6.0' wide and less shall be roll formed section 3.5" x 3.5" with a minimum bending strength of 453.0 pounds on 6.0' cantilever load of 2-7/8" OD galvanized standard weight pipe with minimum bending strength of 381.0 pounds on 6.0' cantilever load. Gate posts for gate leaves over 6.0' wide shall be standard weight pipe complying with ASTM-A120 of diameters as recommended by the gate manufacturer. Attachment of chain link fabric to roll formed terminals shall be made by weaving directly into integral lock loops formed in the post. Attachment of chain link fence to tubular terminal posts shall be made with minimum 1/4" x 3/4" tension bar and 12-gauge x 1.0" wide clamps using minimum 3/8" diameter carriage bolts.

Barb wire shall be double strand 12-1/2 gauge twisted wire with 14 gauge, 4-point round aluminum barbs spaced on approximately 5.0" centers conforming to the requirements of ASTM-A585-71. Extension arms to accommodate barb wire shall withstand a 250 pound pull-down load from end of arm, and have a 3.0" apron around post.

Gate frames shall be tubular shaped, 1.90" outside diameter with welded or steel fitted corners. Braces and trusses shall be furnished when necessary. Hardware shall be of adequate design and strength to provide satisfactory operation of gate. All gate components shall be galvanized or aluminum coated as specified herein for fencing components. Locking hasps with locks keyed to the City of Lafayette Sewer Department master shall be furnished on gates.

All fittings shall be pressed steel or malleable iron and shall be hot-dip galvanized conforming to the requirements of ASTM 153-73. Tie wires shall be minimum 9-gauge aluminum or 11 gauge galvanized steel.

Line and terminal posts to be of sufficient lengths to allow for approximate 36.0" settings into concrete footings. Diameter of footings to be 10.0" for line post, and 12.0" for terminal posts.

All dimensions and gauges of material are subject to accepted industry tolerance standards.

Concealment slatting shall be installed in chain link fence where indicated on the Plans to create a visual barrier. Slatting shall be designed and manufactured specifically for vertical insertion in chain link fencing fabric and shall self-lock in place in the fabric. The slatting shall have a 25-year limited warranty provided by the manufacturer against color fading and breakage of components. Slatting shall be installed according to the manufacturer's recommendations.

Job site shall be cleared of excess spillage of concrete, cut wires, etc., and post hole excavation scattered uniformly away from posts.

Upon request of the Owner or authorized representative, samples of each component shall be submitted for approval prior to fabrication and shipment of fencing for this project. Mill certificates shall confirm compliance with these specifications and fabrication from domestic produced steel.

Any material found not to be in compliance with the herein described specifications shall be removed and replaced at Contractor's expense.

The Contractor shall furnish materials and construct a crushed limestone aggregate surfaced driveway to the pump station in accordance with the details as shown on the construction drawings. The driveway subgrade shall be brought to line and grade within reasonable limits and compacted to a uniform density of at least 95% of maximum density at optimum moisture. The driveway shall be graded to drain and swale side ditches shall be constructed to carry the drainage run-off to the main road ditch.

The area located between the pump station wet well and valve box structure and the fence shall be surfaced with limestone aggregate to the depth indicated on the construction drawings.

The crushed limestone aggregate surfacing shall be compacted to 95% of maximum density for full depth of the surface course.

The Contractor shall furnish and install pipe culverts in the location and of the type and size as shown on the construction drawings. Reinforced concrete pipe shall conform to the requirements of ASTM Designation C-76, for Class III, Wall B (Table III) pipe.

#### **ARTICLE 17 - WORKMANSHIP AND GUARANTEE**

The Contractor shall furnish a written guarantee which shall warrant the pumps, motors, and appurtenant equipment against defects in workmanship and materials for a period of 5 years under normal use, operation and service.

The Contractor shall furnish a written guarantee covering all other parts and equipment for one year from the date of acceptance by Owner. It shall be warranted that all parts and equipment are free from defects in design, materials, and workmanship. Replacement parts of all components found to be defective shall be furnished and installed by the Contractor at no additional cost to the Owner during the guarantee period.

The Contractor shall furnish to the Owner at least four copies of instructions for installation, maintenance and operation of the pumps and components, together with parts lists and pump performance curves.

**ARTICLE 18 - FIELD PERFORMANCE TESTS**

Contractor shall ensure that the wet well is free of mud and all debris prior to the lift station start-up field test. Start-up field tests shall be conducted by the pump manufacturer's factory trained start-up representative. The start-up test shall be conducted in the presence of the design engineer, representatives of the Owner, and the contractor.

A start-up test shall be conducted on each pump and shall consist of continuous operation for a period equivalent to drawdown of one half the total volume of the wet well.

The test shall be performed with the motor fully loaded and the wet well water level held above the pump/motor assembly.

**ARTICLE 19 - SHOP DRAWINGS AND SUBMITTALS**

After checking and verifying all field measurements, Contractor shall submit to Engineer for approval five copies of all shop drawings and submittals, which shall have been checked by and stamped with approval of Contractor and identified as Engineer may require. The data shown on the shop drawings and submittals will be complete with respect to dimensions, design criteria, materials of construction, and the like to enable Engineer to review the information as required.

At the time of submission, Contractor shall in writing, call Engineer's attention to any deviations that the shop drawings and submittals may have from the requirements of the contract documents.

Engineer will review and approve with reasonable promptness shop drawings and submittals, but his review and approval shall be only for conformance with the design concept of the project and for compliance with the information given in the contract documents. The approval of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make any corrections required by Engineer and shall return the required number of corrected copies of shop drawings and submittals. Contractor shall direct specific attention in writing or on resubmitted shop drawings and submittals to revisions other than the corrections called for by Engineer on previous submittals. Contractor's stamp of approval on any shop drawing and submittals shall constitute a representation to Owner and Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog number, and similar data or he assumes full responsibility for doing so, and that he has reviewed or coordinated each shop drawing and submittal with the requirements of the work and the contract documents.

No related work shall be commenced until the shop drawing and submittals has been approved by Engineer. A copy of each approved shop drawing and submittal shall be kept in good order by Contractor at the site and shall be available to Engineer.

Engineer's approval of shop drawings and submittals shall not relieve Contractor from his responsibility for any deviations from the requirements of the contract documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submittal and Engineer has given written approval to the specific deviation, nor shall any approval by Engineer relieve Contractor from responsibility for errors or omissions in the shop drawings and submittals.

**ARTICLE 20 - SUBMITTAL FOR APPROVAL AS AN EQUAL**

Where definite models and manufacturers have been specified, it is not the intent to discriminate against any product of another manufacturer. It is the intent to set a definite standard as to the wastewater lift station performances and operating characteristics.

Any manufacturer who wishes to have his equipment approved as equal shall submit to the Engineer, no later than fourteen (14) days prior to the bidding, complete information on its wastewater lift station.

**ARTICLE 21 - PATENTED DEVICES**

The Contractor and manufacturer shall hold the Owner blameless and shall defend any claims for patent infringement which may arise due to purchase, installation and operation of the wastewater lift station. The manufacturer shall provide for the use of any design, device, material, or process covered by letters, patent or copyright.

**ARTICLE 22 - PAYMENT**

Payment for furnishing, installing, testing, and guaranteeing a submersible sewage lift station which includes wet well and valve box structure, bedding material, piping, valves, pumps, motors, access frame and covers, vent pipes, electrical, enclosures, fencing, grading, culvert, site driveway and site limestone surfacing, equipment, dress-up, and all other appurtenances or incidentals necessary for the construction of a fully functional submersible sewage lift station in accordance with the drawings and specifications shall be lump sum.

Payment shall be based on a weighted percent completion of the approved breakdown of lump sum components, i.e., mobilization, wet well, valve box, electrical, pumps, motors, fencing, grading, culvert, access road, dressing-up, etc. The percentages shall be estimated to the nearest 1% for ease of accounting. Payment of the lump sum contract price shall constitute full compensation for equipment, tools, labor, supervision, and incidentals and the performance of all work necessary to complete all items of work described in this section of the specifications and shown on the plans in accordance with the specifications and plans.

**TECHNICAL SPECIFICATIONS  
FOR  
SANITARY SEWERAGE FORCE MAIN**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all supervision, labor, tools, paint, equipment, appliances, and materials required to perform and satisfactorily complete all items of work in connection with the construction of a sanitary sewerage force main.

**ARTICLE 2 - MATERIALS**

Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of AWWA or the appropriate ASTM standard. Submit manufacturer's certifications that ductile iron pipe and fittings meet requirements of the appropriate ANSI standard. Submit a certificate of compliance from the manufacturer stating the chemical and physical properties of the materials used and are in conformance with the specifications.

**A. DUCTILE IRON PIPE**

Pipe shall be designed in accordance with ANSI Specification A21.50 (AWWA C-150) for 200 psi water working pressure. Pipe shall be manufactured in accordance with ANSI Specifications A21.51 (AWWA C-151), latest revision, except the minimum nominal wall thickness shall be shown on the following table:

SIZE	THICKNESS	SIZE	THICKNESS
4"	.26		
6"	.25	12"	.31
8"	.27	14"	.33
10"	.29	16"	.34

Pipe shall be standard cement lined and seal coated with an approximate bituminous coated outside in accordance with ANSI Specification A21.4 (AWWA C104), latest revision, and shall be manufactured by Clow Corporation, American Cast-Iron Pipe Company, or approved equal.

All ductile iron pressure pipe installed exposed or above ground shall be flanged pipe meeting all requirements of ANSI A21.51 (AWWA C151) and ANSI A21.15 (AWWA C115) with a maximum working pressure of 250 psi. Pipe shall be furnished with ductile iron flanges screwed on and drilled and faced in accordance with ANSI B16.1, Class 125. Pipe shall be standard cement lined and seal coated with an approximate bituminous coated outside in accordance with ANSI Specification A21.4 (AWWA C104), latest revision. Outside bituminous coating shall be omitted on all exposed pipe to be painted. Exposed or above ground piping and fittings shall be furnished with factory applied primer on the exterior compatible with the finish coats specified in Section III-2.4 Article 11, Section F, Materials (Painting).

The following joint types shall be used conforming to ANSI Specification A21.11 (AWWA C111), latest revision.

1. Push-on joints shall be equal to the "Super-Bell-Tite Joint", "Fastitie", "Tyton" or approved equal.
2. Mechanical Joint (Type III)
3. Submarine, flexible, ball and socket joint (for underwater installation).

Fittings shall be furnished in accordance with ANSI A21.10 (AWWA C110), ANSI A21.53 (AWWA C153), and ANSI A21.11 (AWWA C111), latest revisions. Fittings shall be asphalt coated outside and cement lined to a standard thickness and seal coated inside in accordance with ANSI Specifications A21.4 (AWWA C104).

**B. PVC PIPE**

2"-12" Pipe shall conform to ASTM 2241, 160 psi working pressure, standard dimension ration SDR 26, shall be made from clean virgin, NSF approved, Type I, Grade I, Polyvinyl Chloride (PVC) compound conforming to ASTM Resin Specifications D 1784.

14"-24" Pipe shall conform to the following: 165 psi working pressure, standard dimension ration SDR 25, AWWA C900, NSF approved, Cell Class 12454 B PVC compound conforming to ASTM Resin Specification D1784.

Clean reworked material generated from the manufacturer's own pipe production may be used. Fittings for pipe smaller than three inches (3") in diameter shall be made from the same material as the pipe with a 160 psi working pressure rating. Fittings three inches (3") and larger diameter pipe shall be ductile iron with restrained mechanical joint fittings conforming to Article 2E of this section.

Joint material shall be rubber gasketing conforming to ASTM D3139 and ASTM F477 Specification. PVC pipe shall be supplied in nominal laying lengths of 20'. The color of pipe shall be green. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation.

**C. POLYETHYLENE PIPE (P.E. PIPE)**

P.E. Pipe 2" or less shall be in accordance with PE 4710, minimum cell classification valves shall be 445574 CC3 in accordance with ASTM D3035, 250 psi pressure rating, SDR9.

DIAMETER (INCHES)	OUTSIDE DIAMETER (INCHES)	MINIMUM WALL THICKNESS (INCHES)
1-1/4"	1.660"	0.184"
1-1/2"	1.900"	0.211"
2"	2.375"	0.264"

P.E. Pipe greater than 2" shall be in accordance with PE 4710, minimum cell classification valves shall be 445576C in accordance with ASTM D3350, 200 psi pressure rating, SDR11.

Joints shall be butt fused.

Fittings shall be molded from a polyethylene compound having a cell classification equal to or exceeding the pipe compound; supplied by the same manufacturer of the pipe being supplied. Transition Fittings shall be a mechanical joint adapter (Harvey Adapter) fabricated from HDPE pipe conforming to ASTM 3350. The adapter shall have a pre-positioned stainless steel stiffener and shall offer full axial restraint, by means of a restraining gland. Payment for Harvey Adapters is included in the unit price for installation of P.E. Pipe.

HDPE sewer force main pipe shall have a green colored stripe along the entire exterior length of the pipe. Sample of pipe and physical and chemical data sheets shall be supplied to the Engineer for approval and his approval shall be obtained before pipe is purchased. The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. At the option of the owner, manufacturers may be disqualified if they do not have proper experience in the manufacture of the material specified.

**D. FUSED PVC**

Fusion-joined PVC pipe and fittings shall be made from clean, virgin NSF approved Type I, Grade I PVC conforming to ASTM Resin Specification D1784-65T.

(4"-24") Fusion-joined PVC pipe shall be Fusible AWWA C-900, Standard dimension ration SDR 18, 235 psi pressure, NSF approved, 12454 B PVC compound conforming to ASTM Resin Specification D1784.

Fittings shall be ductile iron and must conform to Article 2.E.

Fusion-joined PVC shall be joined by a pipe manufacturer-certified technician with manufacturer approved equipment and shall include a means of logging fusion process data.

The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. PVC pipe shall be supplied in nominal laying lengths of 20'. The color of pipe shall be green. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation. The chemical compounds for fusion-joined PVC pipe shall be formulated to facilitate the thermal-fusion process.

#### **E. DETECTION WIRE**

A THW 12 insulated copper wire shall be placed over the center of all PVC and PE pipe for its entire length including crossing. This wire must be attached to all fixtures and appurtenances to ensure continuous flow of electrical current. This wire must be connected from the discharge pipe inside the pump station to the ring of the discharge manhole. Splices in detection wire shall be installed in a direct bury splice kit manufactured by 3M or approved equal. All work shall conform to the detail on the construction plans. Payment for the detection wire and splice kit is included in the unit price for the installation of the PVC pipe.

#### **F. FITTINGS**

Mechanical joint ductile iron fittings shall be used for HDPE, PVC, and Ductile Iron Force Mains downstream of the valve vault. Ductile iron fittings shall be manufactured in accordance with ANSI A21.10/AWWA C110 standard body or ANSI A21.53/AWWA C153 compact body. The rated working pressure shall be 350 psi for 24-inch and smaller and 250 psi for 30-in and larger. All mechanical joint fittings shall be installed with restraining glands in addition to concrete thrust blocks. Restraining glands shall be Megalug Series 1100 PV or Series 2000PV by EBAA Iron Sales, Inc, or approved equal. Sufficient quantities of gaskets and/or glands, bolts and nuts shall be furnished to provide for each socket opening. Bolts and nuts shall be alloy steel (Corten type). Fittings shall be asphalt coated outside and cement lined to a standard thickness and seal coated inside in accordance with ANSI Specifications A21.4 (AWWA C104).

Concrete thrust blocks shall be provided at all fittings and bends. Thrust blocks shall conform to table on sewer detail sheet.

#### **G. CASING**

Casing shall be welded smooth steel pipe conforming to API 5L Grade B or ASA B36.10, coated inside and outside with asphalt or painted with two (2) coats of bitumastic paint. Wall thickness shall be 0.375 inches minimum unless a greater thickness is shown on the construction plans. Joints shall be welded. Ends of casing shall be properly sealed.

Spacers shall be installed around the carrier pipe inside the casing. The casing spacers shall be constructed of stainless steel bands with abrasion resistant dielectric runners. The casing spacers shall be installed at a spacing and location recommended by the manufacturer. Casing spacers shall be Model SSI Stainless Steel Casing Spacers by Advance Products and Systems, or approved equal.

#### **H. WATERTIGHT CONNECTORS**

Connectors shall meet ASTM C923, shall be KOR-N-SEAL flexible watertight connectors as manufactured by NPL Systems, Inc., or approved equal.

#### **I. VALVES AND BOXES**

The gate valves to be supplied under this contract shall be mechanical joint gate valves (4 inch thru 12 inch) having a resilient seat and shall conform to AWWA Specification C509 or C515 and UL/FM approved.

Design of gate valves four (4") inch through twelve (12") inch shall provide non-rising stem (NRS), dual seal between gate and body, smooth closing gate and one piece cast iron wedge with integral lugs. Valve shall be furnished with standard o-ring seals, two o-ring seals shall be set above the stem thrust collar and one below. Direction to open shall be

counter-clockwise equivalent to American Flow 2500, M&H 4067-01 or 7571, Clow F6100 (C509 or C515) or Mueller A-2360. Makes and models shall be approved by the Engineer.

Valves for use with 2 inch pipe shall be AWWA non-rising stem, iron body, bronze mounted, double-disk gate valves, similar to the type specified for larger sizes, except that the joints shall be screwed ends.

Valves shall be provided with 2 inch operating nuts marked to indicate the direction of opening. Valves shall be opened counterclockwise.

Valve boxes for all valves of 12 inch diameter and smaller shall be made of cast iron and shall be of the heavy roadway type with inside diameter of not less than 5 inches. The top section shall be adjustable for elevation. The base shall be sufficiently enlarged so that it will not come in contact with the valve or pipe at any point. All valve boxes shall be provided with covers on which the word "WATER" is printed in raised letters. A pre-cast concrete pad shall be installed for all valve boxes outside of pavement.

Valves larger than 12 inch nominal diameter shall be approved by the Engineer.

#### J. TAPPING SLEEVES AND VALVES

Mechanical joint type cast iron tapping sleeves and valves shall be used where indicated on the drawings or where required by the Engineer to make connections to existing 4 inch and larger water mains. Tapping sleeves shall be 304 stainless steel with stainless steel flange, bolts, and nuts as manufactured by Mueller H-304SS, Romac SST, Smith Blair 663, and Ford Fast, or approved equal. The tapping valves shall have a resilient seat and shall conform to AWWA Specifications C509 or C515. Tapping valves manufactures shall be Kennedy, Clow, M&H, American Flow, Mueller or approved equal

#### K. CUT-IN SLEEVES AND VALVES

Cut-in valves shall be furnished with mechanical joints. Cut-in sleeves shall be Mueller H-842, or approved equal. Cut-in valves shall be equal to gate valves specified hereinabove, Mueller Number H-866, or approved equal. A valve box shall be furnished and installed with each cut-in valve.

#### L. AGGREGATE

##### Limestone

Limestone shall consist of 100% crushed limestone aggregate and shall show not more than 45% loss when tested in accordance with AASHTO Designation: T 96 and shall show not more than 15% loss when tested in accordance with AASHTO Designation: T 104 and shall be graded as follows:

<b>#610</b>	
<b>U.S. SIEVE</b>	<b>PERCENT PASSING (BY WEIGHT)</b>
1-1/2"	100%
1"	95 - 100
1/2"	62 - 90
Number 4	40 - 70
Number 40	12 - 32

### **M. Marking Tape**

All PVC pipe shall be marked using a nonmetallic tape buried at least 15 inches above the top of the pipe. Water mains shall be marked with blue tape. Tape shall be 3 inches wide minimum and on the Board's list of materials and approved manufacturers. After the tracer wire has been placed, the pipe trench shall be backfilled to approximately 15 inches over the top of the pipe then the nonmetallic tape shall be placed flat over top of pipe within trench. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the tape is secured in place over the pipe. It is the intent to provide a visible marker in the event of excavation near a water line.

### **ARTICLE 3 - GENERAL**

All work and materials required in the installation of the water mains shall be in compliance with specific requirements of these specifications. Any items of work not mentioned specifically herein shall be performed in compliance with the current revision of the equal AWWA regulation for the type pipe being used. Conform to applicable state and local codes for installation and testing of in this section.

### **ARTICLE 4 - LOCATION OF MAINS**

Main shall be installed to the lines and grades as shown on drawings. Force mains shall be installed with a clear distance of not less than six (6') feet from water lines parallel thereto and not less than eighteen (18'') inch from water lines vertically.

### **ARTICLE 5 - TRENCHING**

All excavated material shall be placed in such a manner as not to endanger the work, and so that free access to all parts of the trench, fire alarm boxes, fire hydrants, where they exist, may be had at all times, and in such a manner as to inconvenience the public as little as possible. Reasonable and satisfactory provisions shall be made for travel on sidewalks, crosswalks, streets and private ways. No streets shall be closed to through traffic without the permission of the Owner or his agents. All drains, gutters, culverts and sewers for surface drainage shall be kept open, or if they are unavoidably closed, other provisions shall be made for this drainage. Trenches and open holes shall be properly protected from accidental entry.

The Contractor will be required to keep the sides of the trench as nearly vertical as possible by means of sheathing, bracing, etc., as may be required to thoroughly support the sides of the excavation, and to prevent any movement that might injure the main, diminish the width necessary for proper drainage, or otherwise injure or delay the work or seriously interfere with adjoining structures or operations. If sheathing is used, the bottom width of the trench in the clear shall be 12 inches wider than the greatest horizontal diameter of the force main. Unless otherwise ordered by the Engineer, that portion of sheathing in the trench extending below the top of the force main shall not be withdrawn before more than 6 inches of earth is placed above the top of the main. As the trench is backfilled, the sheathing and bracing shall be removed in such a manner as will avoid the caving in of the trench. The vacancy left by the sheathing shall be carefully filled. If the sheathing cannot be removed without injury to the water main or to the adjoining structures, it shall be left in place, or it shall be cut where directed and the upper part shall be removed.

The length of the trench to be opened or the area of surface to be disturbed and unrestored at any one time will be limited by the Engineer with regard to both expeditious construction and the convenience and comfort of persons residing in the neighborhood or frequenting the street in question. Unless authorized by the Engineer, there shall not be more than 200 feet of trench opened in advance of a section of completed force main, such completed section shall be a length of pipe which is in the process of being backfilled and/or tested.

The Engineer reserves the right to control the length of trench opened in advance of pipe installation if, in his opinion, the laying, and testing of pipe is not proceeding fast enough to complete the installation and backfilling within a reasonable length of time.

The Contractor shall furnish all labor and equipment necessary for pumping and shall pump or otherwise remove any water that shall be found or shall accumulate in the trenches. Trenches and other excavations shall be kept clear of water while pipe is being laid or concrete or masonry is being placed. No pipe or appurtenances shall be laid in water, and water shall not be allowed to flow over or rise up on any pipe until the work has been tested, and accepted.

The minimum cover over force mains 8 inches nominal diameter or less shall be 36 inches and for force mains 10 inches nominal diameter or greater, the minimal cover over the pipe shall be 48 inches, except where required to meet existing lines. The bottom of the trench shall be excavated to a uniform grade and shall be free from obstruction which would result in the weight of the pipe being concentrated at certain points. The bottom of the trench shall be free from rocks, clods or other sharp-edged objects.

Where subsurface obstructions are encountered in the above trenching, the Contractor will be permitted to lay pipe above the obstruction if the minimum cover required can be obtained while providing a cushion at least 6 inches thick between the bottom of the pipe and the top of the obstruction.

Where the 6" minimum cover cannot be obtained above the obstruction, the Contractor will be required to lay pipe under the obstruction and he will receive no additional compensation for additional depth of bury will be paid constructing the line in this manner.

All landscaping, trees, telephone poles, power poles, etc., along the line of work shall be protected, and sufficient barricades, warning lights, etc., shall be provided for the protection of the public.

Where force mains are to be laid beneath roadways, sidewalks, and driveways, the Contractor will not be permitted to cut and replace this pavement except where specified or in special cases where no other practical method for installation is available.

With this exception, all force mains under pavements shall be installed by means of a boring machine, auger, jack, or by other means satisfactory to the Engineer. In the event subsurface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks on either side of the pipeline, or is otherwise disturbed or broken due to the Contractor's operation, he shall repair or replace same at his own expense without further compensation.

Any necessary concrete and asphalt repairs should be made in accordance with the appropriate Section of Louisiana Standard Specifications for Road and Bridges 2016.

In excavating, backfilling and laying pipe, care shall be taken not to remove, disturb or injure other pipes, conduit or structures, without prior notice to the Engineer. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation, and within a reasonable time shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the Engineer at no additional cost to the Owner. All existing water line restraints disturbed by the Contractor shall be replaced at no additional cost to the Owner.

The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc., and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the execution of the work, the Contractor shall be responsible for any damage to persons or property caused by such breaks.

When pipe or conduits providing service to adjoining buildings are broken during the progress of the work, the Contractor shall repair them at once at his own expense, or if preferred by the utility involved, shall pay the utility the proper charges for having such repairs made by their own forces. Delays such as would result in buildings being without service overnight or for needlessly long periods during the day will not be tolerated, and the Owner reserves the right to make repairs at the Contractor's expense without prior notification. Should it become necessary to move a portion of a pipe, conduit or structure, it shall be done by the Contractor in strict accordance with instructions given by the Engineers or the utility involved.

#### **ARTICLE 6 - PIPE INSTALLATION**

Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

Where, in the opinion of the Engineer, the floor of the trench is not sufficiently stable to prevent vertical or lateral movement of the pipe after installation, the pipe shall be laid on a timber foundation or the trench shall be excavated below grade and brought back to grade with suitable filling of limestone or select fill material, as directed. There shall be no extra payment for pipe foundations filled with select fill material or limestone.

Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose or unsuitable soil.

Thoroughly clean interior of pipe before lowering into the trench while keeping pipe interior free of foreign matter during laying operations.

When work is not in progress, the ends of the pipe and fittings shall be sealed so foreign material cannot enter pipe.

The pipe shall be installed and backfilled in accordance with the manufacturer's specifications.

Pipe laying operations shall not block, obstruct, or prevent streams, ditches, canals, culverts, conduits, or gutters from carrying their normal flows or of serving their normal function without the approval of the Engineer. Any disruption shall be restored by the Contractor.

The trench shall provide continuous support for the pipe without voids or soft spots under the pipe.

Concrete thrust blocks shall be provided at all fittings where a change of direction occurs or as specified by the Engineer for all pipe three (3") in diameter or greater. Thrust blocks shall be poured against undisturbed soil and shall not cover the bolts or nuts on the fittings. A plastic barrier shall protect bolts or nuts from being covered. Concrete for thrust blocks and pads shall be 3000 psi at twenty eight (28) days. Concrete shall be ready mix; not Sakrete.

The force main shall be installed in steel casing where indicated in the Drawings, typically under state highways, railroads, or as indicated by the Engineer.

Pipe shall be laid beneath all ditches, sewers, culverts, pipes, conduits, drainage canals, tracks and similar structures. Regular pipe laying methods shall be used in all such cases except where special crossings are indicated.

Sewer service shall be maintained without interruptions as much as possible. The Owner may require that major connections which require lengthy interruptions to service be made during periods of low sewer use or that bypass pumping be provided by the Contractor at no additional cost to the Owner.

Assembly of fittings and other preparatory work shall be done in advance to reduce the off time and to keep interruption to a minimum.

#### **ARTICLE 7 - CROSSING OF STREAMS, CANALS, TRACKS**

The Owner will obtain necessary permits to cross canals, tracks, streams, or waterways and shall pay any fees required. The Contractor shall comply with the conditions or restrictions of all such permits.

#### **ARTICLE 8 - BACKFILLING**

Preform backfill operations and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.

Re-excavation of the trench for replacement of pipe, tapping, or testing shall be done by the Contractor at no additional cost to the Owner.

The Owner reserves the right to order any trench or trenches backfilled at any time after installation of pipe if the particular trench remaining open constitutes a public nuisance.

Outside of Public Right-of-Ways:

1. Compact excavated material around and to a depth of 12" above the pipe for the entire length of the trench to 90 percent of maximum standard proctor density in 6" to 8" lifts.
2. The remaining portion of the trench shall be backfilled in 12" lifts and thoroughly compacted leaving a slightly crowned condition, not to exceed 12" above natural ground.

Inside of Public Right-of-Ways: Outside of Public Roadways:

1. Compact excavated material around and to a depth of 12" above the pipe for the entire length of the trench to 95 percent of maximum standard proctor density in 6" to 8" lifts.
2. The remaining portion of the trench shall be backfilled in 12" lifts and thoroughly compacted leaving a slightly crowned condition, not to exceed 12" above natural ground.

Underneath roadways, streets, shoulders, walks, and drives (as per details in the drawings):

1. Limestone shall be compacted in 12" lifts to 95 percent density up to 3" (min.) –12" (max.) above pipe.
2. A mechanical vibrator shall be used to compact the limestone.
3. The remainder of the trench shall be filled with fill-crete (188 lbs. of cement, 3010 lbs. of sand, and 46.2 gals. of water).

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass, plots, etc., and the work area shall be left in a tidy and acceptable condition. The Contractor will not generally be required to regrass or seed lawns or neutral grounds where trenches are excavated in these locations unless specified otherwise. However, salvaging and replacement of sod on lawns may be ordered by the Engineer at no additional cost to the Owner. All surplus material shall be removed by the Contractor and shall be disposed of at locations and in a manner approved by the Engineer.

#### **ARTICLE 9 - SPECIAL BACKFILL**

Special backfill shall be used as directed by the Engineer where the excavated material is not suitable for backfilling the trench and obtaining the required compaction. Special backfill shall be soils conforming to DOTD Designation: TR 423, Class A-4, or better, with a maximum liquid limit of 35 and a maximum plasticity index of 15. The material shall be free from sod, weeds, grass and other objectionable matter. Sand will **not** be allowed for use as special backfill.

The special backfill material shall be compacted by approved methods to 100% of the density of the surrounding material determined in accordance with AASHTO Designation: T 99 (or to 95% of maximum density inside street right-of-way or servitude) unless specified otherwise.

#### **ARTICLE 10 - REPLACING STREET SURFACING AND SIDEWALKS**

In all paved or improved streets, the surface of the filled trenches (after the filling has dried and settled) shall, at the direction of the Engineer, be finished without any needless delay and in the best workmanlike manner with the same kind of roadway or sidewalk improvement that was removed in excavating the trench. The underlying foundation courses, as well as the finished surface, shall conform to the undisturbed portion of the roadway, or sidewalk, and shall in every respect be equal in quality, materials and workmanship. For this restoration, the Contractor will be paid the price bid per square yard for each class of surfacing. Concrete driveways and parking areas must be saw cut, and restored to the same thickness as the existing surfacing or a minimum thickness of 6 inches, whichever is greater. A 6" x 6" x #6 wire mesh steel reinforcement shall be required for concrete drives and parking areas. Place reinforcement in the middle of the pavement.

Thickness of replaced sections of sidewalks shall be that of the existing thickness or a minimum four (4) inches, whichever is greater.

The decision of the Engineer shall be final as to the classifying of any form of pavement or surfacing not specified in the contract or of any forms where the classification is at all doubtful.

In bidding on repairs of pavement made up of two (2) or more courses, all the courses shall be considered as integral parts of the pavement; the price bid shall be for replacement of the pavement complete, including foundation, intermediate course (if present) and surface.

As soon as the roadway or sidewalk improvement which was disturbed by the Contractor has been replaced, all refuse or surplus materials deposited or left by the Contractor on the street shall be removed and the area shall be restored in all respects to as good a condition as before trenching was commenced.

No measurement of any pavement for payment will be made until the entire block or section is placed in proper condition and the above requirements are complied with.

Should the street or sidewalk surfacing, curbs, gutters, bridges, etc., outside the width measured for payment (as provided in paragraph above) be damaged, cracked, settled, disturbed or injured in any manner by the work, such damage or injury must be replaced and the surfacing, etc., restored to its former condition at no additional cost to the Owner.

Should the Contractor fail or refuse to repair any such damage, the Owner may, after twenty-four (24) hours written or verbal notice, employ such forces and furnish such materials as may be necessary and do the work, deducting the actual cost thereof from any amounts due or to become due to the Contractor

#### **ARTICLE 11 - EXISTING STRUCTURES**

Existing structures shall be defined as all above and below ground structures, including all pipelines, poles, tracks, roads, culverts, sidewalks, drains, cables, wires, conduits, vaults, manholes, landscaping, and other appurtenant facilities, whether owned or operated by public bodies, private individuals, corporation, firms or companies.

Protect all existing structures from damage during construction.

Utility facilities shown on the plans are approximate locations (not scalable) and do not include service locations. There is no expressed or implied guarantee as to the accuracy of the various utilities or any omissions.

The Contractor shall verify the locations of all utilities and shall adhere to the provisions of OSHA 29 CFR 1926.651 at no cost to the Owner. Final project location will be determined in the field by the Engineer upon the Contractor's verification of all utilities.

In no case shall the Contractor receive additional compensation due to the location of existing utilities in relation to the final location of the proposed lines and appurtenances.

Notify all utilities or other interested parties prior to starting work and advise them of any adjustments required.

Contractor shall be responsible for investigating and informing himself of the condition, character and extent of all structures which may be encountered during construction.

Perform work in a manner to prevent interference with or damage to existing structures. Any damages done by the Contractor shall be his responsibility and all repairs shall be made immediately to the satisfaction of the Engineer.

The Owner and/or their agents shall not be responsible for any damages to or any costs incurred as a result of any delays due to existence, removal, adjustment or repair to any structures mentioned herein, shown on the plans or encountered during construction.

#### **ARTICLE 12 - TESTING**

Testing shall be a part of the pipe installation, and water for the test will be furnished by the Contractor who shall be responsible for the delivery on the job site. Tests shall be made at the request of the Engineer and all equipment and labor required to satisfactorily test the pipe shall be furnished by the Contractor.

All joints shall be fully exposed during the testing, with the exception that prior backfilling may be allowed in accordance with the terms of Article 7. Water shall be admitted to the lines as soon as possible after the pipe is laid. The line shall be brought to full test pressure and all leaks shall be eliminated immediately. The test pressure shall be 100 psi.

This test shall be performed on all sections of the force main so that all pipe, valves and fittings are subject to the test. The test pressure shall be maintained continuously by pumping for a period of at least one (1) hour. At the end of the first hour, the pressure shall meet the requirements stated above. Pumping shall then be discontinued for a period of not less than two (2) hours or until the Engineer has inspected and approved the test section, whichever is longer. The initial test pressure shall then be restored by pumping and the quantity of water pumped into the line to accomplish this shall be measured accurately. This quantity shall not exceed the allowable leakage which is one-half (1/2) gallons per inch per hour per mile of pipe.

**ARTICLE 13 - CARE OF STREETS, SIDEWALKS, AND ROADS**

The Contractor shall be required, at his own expense, to remove all excess materials, debris or other obstruction from the streets or roads immediately after the backfilling has been completed. Wash the streets and sidewalks daily if necessary to remove the dust problem. No cross streets, sidewalks or roads shall be wholly obstructed except by special permission from the Engineer. If at any time the Contractor neglects to remove such material or obstruction and place streets, sidewalks and roads in suitable condition for traffic within 24 hours after having received notice (written or verbal) from the Engineer, the work may be done by the Owner, and the cost thereof charged to the Contractor and deducted from his final estimate. The Contractor shall repair or replace streets, sidewalks, roads, and culverts to the satisfaction of the Engineer and parties concerned.

**ARTICLE 14 - PROTECTION AND CARE OF PUBLIC OR PRIVATE PROPERTY AND EASEMENTS**

The Contractor shall continuously maintain and protect all underground and above ground structures, utilities, including the restoration of all public utilities, water mains, water services, gas mains, gas services, culverts, drains, ditches, curbs, sidewalks, landscaping and/or other facilities which may be damaged, to a condition at least equal to their original status, at no additional cost to the Owner. In the event of damage to any facilities, the appropriate utility will be notified immediately. The Owner will repair damaged facilities at the Contractor's expense or require the Contractor to repair said damage.

All construction work under this contract on easements, right of way or franchise shall be confined to the limits of such easements, right of way or franchise. If work is required on private property the contractor will be required to obtain a right-of-entry from the property owner. All work shall be accomplished so as to cause the least amount of disturbance and a minimum amount of damage.

Prior to excavation on an easement or private right of way, and where required by the Engineer, the Contractor shall strip top soil from the trench or construction area and stockpile it in such a manner that it may be replaced by him, upon completion of construction. No trees or shrubbery shall be removed or trimmed without consent of the Engineer. Ornamental trees and shrubbery shall be carefully removed, with the earth surrounding their roots wrapped in burlap and replanted in their original positions with 48 hours. All shrubbery or trees destroyed or damaged shall be replaced by the Contractor with material of equal quality at no additional cost to the Owner. In the event that it is necessary to trench through any lawn areas, the sod shall be carefully cut, rolled and replaced after the trenches have been backfilled, the backfilling and compacting to be as described for surfaced areas. The lawn area shall then be cleaned, by sweeping or other means, of all earth and debris.

All obstacles such as fences, markers, mail boxes, driveway culverts, etc., shall be removed by the Contractor and immediately replaced after trench is backfilled in their original position and condition at no direct cost to the owner. The Contractor shall notify the Engineer and property Owner at least 24 hours in advance of any work done on easements or right-of-ways.

It is expressly understood that the Contractor shall restore all easements and right of ways to a condition equal to their original condition, and in a condition satisfactory to the property owners and the Engineers.

The Contractor shall maintain adequate drainage during the process of construction. Performance of this work is not payable directly, but shall be considered as a subsidiary obligation of the Contractor, covered under the contract price for the construction items.

All trees, stumps, slashing, brush, excess soil, waste, rubbish, or other debris removed from the sites as a preliminary to the construction work or during construction, shall be removed from the property and disposed of in a manner and a location that complies with local ordinances and laws acceptable to all parties concerned and is approved by the Engineer.

When disposal of excess soil is upon private lands, the contractor shall be required to produce a written agreement with the private land owner stating the agreed terms and conditions.

**ARTICLE 15 - MAINTENANCE OF TRAFFIC AND COMMUNICATIONS**

Refer to Louisiana Department of Transportation Temporary Traffic Control Specifications and Special Details, "The Work Area Traffic Control Handbook" (for Lafayette City-Parish streets), and US Department of Transportation Federal Highway Administration "Manual on Uniform Traffic Control Devices" Part VI, Traffic Controls for Streets and Highway Construction and Maintenance Operations.

The Contractor shall conduct his operations in such a manner so that interference with public travel and inconvenience to the public and to property owners will be minimized. Operations shall be so conducted as to cause minimum interference with access to the property on the streets under construction. The Contractor shall provide and maintain, at his own expense, suitable bridges, detours or other temporary facilities for the accommodation of public or private travel, as directed by the Engineer. Twenty-four-hour notice to owners of private driveways shall be given prior to interfering with them. Maintenance of traffic may be curtailed providing that the Contractor shall obtain permission from the owner or tenants of private property, or proper public authority, or both, to obstruct traffic within the said limits and time agreed upon. The Contractor shall notify the Engineer immediately of any such agreement. The Contractor shall keep the local fire protection authorities informed at all times of the location of construction operations and fire lanes and shall maintain access for firefighting equipment as requested by the Fire Department. One-way traffic shall be maintained on all streets during construction, except where suitable detours or other arrangements are agreed to. A flagman (flagmen) shall be provided as required in this section. Upon completion of backfilling of all excavations in roadways and streets, the Contractor shall have a motorized rubber wheel road grader on the job site. This grader shall be used to maintain all streets and roadways in a satisfactory condition approved by the Engineer for the duration of the contract.

The Contractor shall have someone available to take calls at all times. He shall provide the Owner and the Engineer with a night telephone number to call so that he may be advised of any emergency, trouble or other matter requiring his attention.

**ARTICLE 16 – TEMPORARY TRAFFIC CONTROL**

The Contractor shall furnish Temporary Traffic Control in accordance Section 713 Temporary Traffic Control of Louisiana Standard Specifications for Roads and Bridges 2016 Edition and Manual on Uniform Traffic Control Devices (MUTCD).

**ARTICLE 17- COOPERATING WITH CITY UTILITIES**

Connections to the system shall be made in accordance with the plans. The Contractor shall cooperate with the Sewer Superintendent of the Owner's Utilities System in scheduling work and making connections.

**ARTICLE 18 - PAYMENT****A. FORCE MAIN**

The basis of measurement and payment for installing force mains shall be the linear foot of force main of the various sizes and types actually installed excluding force main that is required to complete other items of work which have been defined in the bid. Measurement shall be from center line of fitting or appurtenance to center line of fitting or appurtenance.

Payment for force mains, measured as provided above, will be at the contract unit price per linear foot for "(Size) Force Mains (Type Specified)" and shall constitute full compensation for furnishing all pipe, joints, fittings, thrust blocks, and other materials, including all appurtenances, not specifically provided for elsewhere in the specifications, and furnishing all labor, equipment and appliances necessary for unloading, hauling, installing, testing, excavating, trenching, sheathing, shoring, bracing, pipe foundation, backfilling, and disposition of surplus excavated material, and incidentals necessary to complete all items of work in accordance with the drawings and specifications.

**B. JACKING OR BORING**

The basis of measurement shall be by the linear foot and shall be the actual center line length of pipe so installed as measured from the vertical cut nearest to and on each side of the obstruction to be bored but shall not exceed 2 feet beyond the obstruction. The vertical cut nearest to and on each side of the obstruction shall be approved by the Engineer. Jacking and boring operations shall in no way interfere with the operation of railroads, streets, highways, or other facilities and shall not weaken or damage such facilities. Jacking or boring HDPE pipe quantity shall include

adapters, reducers and fittings necessary to tie-in HDPE pipe to PVC Pipe.

Payment for jacking or boring force mains will be at the unit price bid for furnishing and laying pipe as stated in Paragraph A above, plus the price bid as extra for installing pipe by the jacking and/or boring method, which shall be full compensation for furnishing all materials, labor, tools, equipment, excavation, sheathing, shoring, backfill, hauling, unloading, testing, disposition of surplus excavated material and incidentals necessary to complete work.

Payment for jacking or boring casing pipe will be at the unit price bid for furnishing and installing pipe as stated in Paragraph C above, plus the price bid as extra for installing pipe by the jacking and/or boring method, which shall be full compensation for furnishing all materials, labor, tools, equipment, excavation, sheathing, shoring, backfill, hauling, unloading, testing, disposition of surplus excavated material and incidentals necessary to complete work.

In the event sub-surface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks are caused on either side of the pipe line, or should the paving be otherwise disturbed or broken due to the Contractor's operation, he shall repair or replace same to its original condition or better at no additional cost to the Owner.

#### **C. CASING PIPE**

The basis of measurement shall be by the linear foot and shall be the actual center line of casing so installed.

Payment for casing so installed will be at the unit price bid for furnishing and installing the casing pipe. Force mains laid in the casing shall be paid for as stated in Paragraph A above. No direct payment will be made for casing spacers installed around the carrier pipe in the casing.

#### **D. REPLACEMENT OF STREET, DRIVEWAY AND SIDEWALK SURFACING**

Measurement of removal and replacement of street, highway, driveway, and sidewalk pavement, when ordered by the Engineer, shall be determined by multiplying the length of trench cutting the pavement by the width of the pavement replaced, except that the pay width shall not exceed the sum of the diameter of the pipe plus 2 feet.

Separate payment shall be made for gravel, shell or limestone surfacing unless specified otherwise.

Payment for removal and replacement of highway, street and sidewalk paving shall be paid for by the unit price bid per square yard and by the square yard for gravel and shell. The payment shall constitute full compensation for removal of existing paving, backfill, compaction, subgrade preparation, finishing and curing, temporary planking and surfacing; for furnishing and hauling and installing all materials for a permanent surface repair; and for furnishing equipment, tools, labor, supervision and other incidentals necessary to complete this item in accordance with these specifications and as shown on the plans. The unit price shall also include saw cutting of the street, highway, driveway, and sidewalk pavement and base with a concrete saw so that a neat, straight joint shall be exposed after the repair is complete. Replacing damaged culverts under streets, highways, driveways, or sidewalks shall be included in this unit price. The concrete finish on the driveway or sidewalk shall be as directed by the Engineer.

#### **E. SPECIAL BACKFILL**

Measurement for special backfill for foundation or for backfill over pipe shall be based on the theoretical in place volume in cubic yards obtained by multiplying the width of the trench by the length and by the depth less 2 feet. The maximum pay width shall be 3 feet which is the maximum trench width shown on the detail on the plans. Payment for special backfill shall be by the cubic yard in place at the contract unit price for "Special Backfill" and shall constitute full compensation for furnishing, hauling, placing and compacting the backfill and removal of the excavated material and disposing of it.

#### **F. TIE-IN TO LIFT STATION OR MANHOLES**

Connections to existing lift station and manholes will be paid for per each, and includes full compensation for furnishing all material, equipment, tools, labor and incidentals necessary to complete the connection. This item shall include watertight connector and drop at force main tie in location, and shall be installed as shown on the standard details.

**G. FORCE MAIN REMOVAL**

The basis of measurement and payment for removing force mains shall be the linear foot of force main of the various sizes and types actually removed excluding force main removal that is required to complete other items of work which have been defined in the bid. Measurement shall be from center line of fitting or appurtenance to center line of fitting or appurtenance.

Payment for force main removal, measured as provided above, will be at the contract unit price per linear foot for "(Size) Force Main Removal (Type Specified)" and shall constitute full compensation for excavation, removal and disposal of force main, fittings, air release valves, and air release valve manholes, furnishing, hauling, placing and compacting backfill, labor, tools and equipment, supervision, and all incidentals necessary to complete this work.

**H. GROUTING OF PIPES**

The basis of measurement and payment for grouting abandoned pipes shall be by the linear foot of abandoned-in-place pipe. Measurement shall be along the center line of pipe.

Payment for grouting abandoned pipes shall be full compensation for labor, equipment, materials and incidentals required to mix, transport and place the grout and restore surface at pump ports. The unit price shall include plugs and installation of temporary pumping and venting ports as required to provide complete filling of the abandoned line and proper placement of the grout. Any damage resulting from the pumping operation shall be repaired at the contractor's expense.

**I. BYPASS PUMPING**

The Contractor shall be responsible for providing all necessary labor, supervision, equipment, and materials which are necessary to route existing sewer flow by trucking or pumping during tie-ins. The truck, pump, and bypass lines shall be of adequate capacity and size to handle system flow. No dumping of raw sewage on private property, into streams, storm sewers, or into streets will be allowed under any circumstances.

Payment for bypass pumping shall be considered a subsidiary obligation of the contract and no direct payment will be made for this work.

**J. TIE-IN TO EXISTING MAINS**

Connections to existing mains will be paid for per each, and includes full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the connection. Valves and fittings are measured and paid for under other items. This item will provide payment for connections to existing mains where tapping sleeves and tapping valves are not paid for separately.

Connections to existing mains will be measured by the actual count of each connection according to type and size installed, tested, sterilized and accepted. These connections will be paid for at the contract unit price per each, which price and payment shall constitute full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the item in accordance with plans and specifications.

**K. TAPPING SLEEVES AND VALVES**

Measurement of tapping sleeves and valves shall be based on the number of each size actually installed, and payment shall be at the unit price bid per each.

Payment shall constitute full compensation for furnishing the sleeves and valves, valves, valve boxes, the labor, equipment, tools, materials, supplies, thrust blocks, anchors and other incidentals necessary for complete installation in accordance with these specifications and the contract drawings.

**L. CUT-IN SLEEVES AND VALVES**

Measurement of cut-in sleeves and valves shall be based on number of each size actually installed and payment shall be at the unit price bid per each.

Payment shall constitute full compensation for furnishing of the sleeves and valves, valve boxes, the labor, equipment, tools, materials, supplies, thrust blocks, anchors and other incidentals necessary for complete installation in accordance with these specifications and the contract drawings.

**M. TYPICAL OFFSET**

Measurement of typical offset shall be per each for the limits detailed on plan sheets.

Payment of typical offset shall be per each for as stipulated on the Contract Documents and shall constitute full compensation for furnishing all labor, material, equipment, tools and other incidentals necessary for removal of any existing pipe, any new pipe, fittings, zinc coated all thread rods, deadman assembly, unloading, hauling, installing, testing, disinfecting the lines, excavating, trenching, sheathing, shoring, bracing, pipe foundation, backfilling, disposition of surplus excavated material, and other incidentals necessary to complete this item as shown on the plans.

**ARTICLE 19 - TYPICAL ITEMS FOR PAYMENT**

ITEM	UNIT
"(Size) Force Mains (Type Specified)	Linear Foot
Jack or Bore (Size) Force Main	Linear Foot
Jack or Bore (Size) Steel Casing	Linear Foot
(Size) Casing	Linear Foot
Remove and Replace (Type Surface)	Square Yard
Special Backfill	Cubic Yard
(Type) Aggregate for Maintenance	Cubic Yard
(Size) Tapping Sleeve, Valve and Box	Each
(Size) Cut-In Sleeve, Valve and Box	Each
Tie-In to Existing Manhole	Each
Tie-In to Existing Lift Station	Each
Tie-In to Existing Mains (Size) (Type)	Each
(Size) (Type) Force Main Removal	Linear Foot
Typical Offset	Each
Casing Removal (Size) (Type)	Linear Foot
Grouting of Pipes	Linear Foot

**TECHNICAL SPECIFICATIONS  
FOR  
WATER DISTRIBUTION SYSTEM**

**8.1 INSTALLATION OF WATER LINES**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all supervision, labor, tools, plants, equipment, appliances, and material for the construction of water lines and appurtenances as described in the plans and elsewhere in the specifications.

**ARTICLE 2 - MATERIALS**

Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of AWWA or the appropriate ASTM standard. Submit manufacturer's certifications that ductile iron pipe and fittings meet requirements of the appropriate ANSI standard. Submit a certificate of compliance from the manufacturer showing the chemical and physical properties of the material used and conformance with the required specifications for each item.

All products must conform to the reduced low lead requirements of Act 362 of 2011 (Louisiana Revised State Statutes 40:1299.27.1 "Low Lead in Water Distribution Systems" and Louisiana House Bill 471 of 2011 Regular Session). The lead content of pipe, plumbing fittings and fixtures, solder or flux used in installation or repair of a public water system must not be more than a weighted average of 0.25%.

**A. DUCTILE IRON WATER PIPE**

Pipe shall be designed in accordance with ANSI Specification A21.50 (AWWA C150), latest revision. All pipe shall be designed for the following minimum conditions, unless noted otherwise:

1. Internal working pressure of 250 psi plus 100 psi surge allowance plus safety factor of 2.
2. Earth load of 5 feet of cover or as shown on the plans.
3. Laying Condition Type 2.
4. AASHTO H-20, truck loading.

Pipe shall be manufactured in accordance with ANSI Specification A21.51 (AWWA C151), latest revision, except the minimum nominal wall thickness shall be as shown on the following table:

SIZE	PRESSURE CLASS	THICKNESS
3"	350	0.34
4"	350	0.25
6"	350	0.25
8"	350	0.25
10"	350	0.26
12"	350	0.28
14"	250	0.28
16"	250	0.30
18"	250	0.31
20"	250	0.33
24"	250	0.37
30"	250	0.42

Pipe shall be standard cement lined and seal coated on the inside with a bituminous coat in accordance with ANSI Specification A21.4 (AWWA C104), latest revision. The exterior of the pipe shall be coated, with an asphaltic coating approximately 1 mil thick in accordance with ANSI Specification A21.51 (AWWA C151), latest revision. Ductile iron pipe

shall be as manufactured by American Cast Iron Pipe Company, Clow Corporation, U.S. Pipe and Foundry Company, or approved equal.

All ductile iron pressure pipe installed above ground shall be flanged pipe meeting all requirements of ANSI A21.51 (AWWA C151) and ANSI A21.15 (AWWA C115) with a maximum working pressure of 250 psi. Pipe shall be furnished with ductile iron flanges screwed on and drilled and faced in accordance with ANSI B16.1, Class 125. Above ground piping and fittings shall be furnished with factory applied primer on the exterior compatible with the finish coats specified in Section III-10.2, Treatment Plant Paint Schedule. Pipe and fittings shall be standard cement lined and seal coated on the inside with a bituminous coat in accordance with ANSI Specification A21.4 (AWWA C104), latest revision.

Joints shall be push-on, conforming to ANSI Specification A21.11 (AWWA C111), latest revision, unless noted otherwise. Push-on joints shall be equal to push-on joints manufactured by American Cast Iron Company, U.S. Pipe and Foundry Company, Clow Corporation, or approved equal.

Fittings shall be furnished in accordance with ANSI Specification A21.10 (AWWA C110) for standard body, and ANSI A21.53 (AWWA C153) for compact bodies, or latest revision. Joints shall be mechanical joint or push-on, conforming to ANSI Specification A21.11 (AWWA C111), latest revision. Fittings shall conform to Section III-8.2, Technical Specifications for Water Distribution System: Valves, Hydrants, Fittings and Services, of these specifications.

All ductile iron pressure fittings installed above ground shall be manufactured in accordance with the latest edition of ANSI A21.10/AWWA C110 for standard body or ANSI A21.53/AWWA C153 for compact body and shall be ductile iron. The rated working pressure shall be 350 PSI. Sufficient quantities of gaskets, glands, bolts and nuts shall be furnished to provide for each socket opening. Bolts and nuts shall be alloy steel (Corten Type). Above ground fittings shall be furnished with factory applied primer on the exterior compatible with the finish coats specified in Section III-10.2, Treatment Plant Paint Schedule. All fittings shall be cement lined and seal coated inside in accordance with ANSI A21.4/AWWA C104. Fittings must be manufactured in the United States.

All pipe is to be hydrostatically proof tested to a minimum of 75% yield strength after manufacture. The manufacturer will furnish the Owner sworn certificates that pipe has been manufactured, tested and inspected in accordance with applicable specifications.

## **B. DUCTILE IRON RESTRAINED JOINT PIPE**

Restrained joint pipe shall be ductile iron pipe designed and manufactured in accordance with Section A, Ductile Iron Pipe, of this article. Restrained joint fittings and the restraining components shall be ductile iron in accordance with the applicable requirements of ANSI/AWWA C110/A21.10, C111/A21.11 and C153/A21.53.

Restrained joint pipe and fittings for 12 inch and smaller diameter pipe shall be "Flex-Ring" by American Cast Iron Pipe Company, "TR-Flex" by U.S. Pipe and Foundry Company, "Super-Lock" by Clow Corporation, or approved equal. Restrained joint pipe and fittings for 14 inch and larger diameter pipe shall be "Lok-Ring" by American Cast Iron Pipe Company, "TR-Flex" by U.S. Pipe and Foundry Company, "Super-Lock" by Clow Corporation, or approved equal. Fittings for use with restrained joint pipe shall be ductile iron and shall conform to ANSI/AWWA C110/A21.10 and C153/A21.53. Where bolts are required, they shall be corrosion resistant. Field cut restrained joints shall be installed in accordance with the manufacturer's recommendations. Mechanical joint restraint systems using retainer glands shall not be allowed for pipe of 14 inch and larger diameter unless approved by the Engineer.

## **C. PVC Pipe (<OR= 3 INCHES)**

1. Pipe and fittings shall be made from clean, virgin NSF approved Type I, Grade I PVC conforming to ASTM Resin Specification D1784-65T.
2. PVC pipe shall be supplied in standard nominal laying lengths of 20'. The color shall be blue or white with blue lettering. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation.
3. Pipe shall meet ASTM 2241 pipe standards working pressure of 160 psi, SDR 26, Commercial Standard C5256-63, and be approved by the National Sanitation Foundation.
4. Fittings shall be brass, compression type.

5. Provisions must be made for contraction and expansion at each joint with a rubber ring. Pipe and fitting must be assembled with a non-toxic lubricant.
6. No 2" PVC pipe joint will be allowed under a roadway.

#### D. PVC PIPE (Above 3")

##### 1. PIPE

- a. 4" – 12": AWWA C900, SDR 18, 235 psi pressure, NSF approved, 12454 B PVC compound conforming to ASTM Resin Specification D1784.
- b. 14" – 24": AWWA C900, SDR 18 Dips, 235 psi rating, NSF approved, 12454 B PVC compound conforming to ASTM Resin Specification D1784.
2. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties.
3. Fittings shall be ductile iron and conform to Section III-8.2, Technical Specifications for Water Distribution System: Valves, Hydrants, Fittings, and Services of these specifications.
4. Joints shall be made of gasket bell push-on type. Joints shall be gasket joints conforming to ASTM F477. Joints assembled with non-toxic lubricant.
5. All joints under roadways shall be restrained.
6. PVC pipe shall be supplied in standard nominal laying lengths of 20'. The pipe shall be blue or white in color. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation.

#### E. FUSED PVC

Fusion-joined PVC pipe and fittings shall be made from clean, virgin NSF approved Type I, Grade I PVC conforming to ASTM Resin Specification D1784-65T.

(4"-24") Fusion-joined PVC pipe shall be Fusible AWWA C-900, Standard dimension ration SDR 18, 235 psi pressure, NSF approved, 12454 B PVC compound conforming to ASTM Resin Specification D1784.

Fittings shall be ductile iron and conform to Section III-8.2, Technical Specifications for Water Distribution System: Valves, Hydrants, Fittings, and Services of these specifications.

Fusion-joined PVC shall be joined by a pipe manufacturer-certified technician with manufacturer approved equipment and shall include a means of logging fusion process data.

The pipe shall be homogenous throughout and free from cracks, holes, foreign inclusions or other defects. PVC pipe shall be supplied in nominal laying lengths of 20'. The color of pipe shall be blue. The pipe shall be marked with the size, material code, dimension ratio (DR), AWWA pressure class and AWWA designation. The chemical compounds for fusion-joined PVC pipe shall be formulated to facilitate the thermal-fusion process.

**F. POLYETHYLENE PIPE (PE Pipe)**

1. P.E. Pipe 3" or less shall be in accordance with PE 4710, minimum cell classification valves shall be 445574 CC3 in accordance with ASTM D3035, 250 psi pressure rating, SDR9.

DIAMETER (INCHES)	OUTSIDE DIAMETER (INCHES)	MINIMUM WALL THICKNESS (INCHES)
1-1/4"	1.660"	0.184"
1-1/2"	1.900"	0.211"
2"	2.375"	0.264"
3"	3.500"	0.389"

Fittings shall be molded from a polyethylene compound having a cell classification equal to or exceeding the pipe compound; supplied by the same manufacturer of the pipe being supplied. Transition Fittings shall be a mechanical joint adapter (Harvey Adapter) fabricated from HDPE pipe conforming to ASTM 3350. The adapter shall have a pre-positioned stainless steel stiffener and shall offer full axial restraint, by means of a restraining gland. Payment for Harvey Adapters is included in the unit price for installation of P.E. Pipe.

2. Pipe (>3"): AWWA C906, SDR 11, PE 4710 High Density, DIPS, Cell Classification 445576C, in accordance with ASTM D3350 (black with blue stripes).
3. Transition Fittings shall be mechanical joint adapters (Harvey Adapter) fabricated from HDPE pipe conforming to ASTM D3350. The fittings shall have pre-positioned stiffener and shall offer full axial restraint.

**G. DETECTION WIRE**

A THW 14 insulated copper wire shall be placed over the center of all PVC and PE pipe for its entire length including crossing. This wire must be attached to all fixtures and appurtenances to ensure continuous flow of electrical current. Splices in detection wire shall be installed in a direct bury splice kit manufactured by 3M or approved equal. All work shall conform to the detail on the construction plans. Payment for the detection wire and splice kit is included in the unit price for the installation of the PVC pipe.

**H. CASING**

Casing shall be welded smooth steel pipe conforming to API 5L Grade B or ASA B36.10, coated inside and outside with asphalt or painted with two (2) coats of bitumastic paint. Wall thickness shall be 0.375 inches minimum unless a greater thickness is shown on the construction plans. Joints shall be welded. Ends of casing shall be properly sealed.

Spacers shall be installed around the carrier pipe inside the casing. The casing spacers shall be constructed of stainless steel bands with abrasion resistant dielectric runners. The casing spacers shall be installed at a spacing and location recommended by the manufacturer. Casing spacers shall be Model SSI Stainless Steel Casing Spacers by Advance Products and Systems, or approved equal.

**I. AGGREGATES**

**Limestone**

Limestone shall consist of 100% crushed limestone aggregate and shall show not more than 45% loss when tested in accordance with AASHTO Designation: T 96 and shall show not more than 15% loss when tested in accordance with AASHTO Designation: T 104 and shall be graded as follows:

<b>#610</b>	
<b>U.S. SIEVE</b>	<b>PERCENT PASSING (BY WEIGHT)</b>
1-1/2"	100%
1"	95 - 100
1/2"	62 - 90
Number 4	40 - 70
Number 40	12 - 32

**J. POLYETHYLENE ENCASEMENT**

Polyethylene encasement or wrap shall be installed on ductile iron pipe, fittings and appurtenances within the areas indicated on the construction plans. Polyethylene encasement furnished under these specifications shall conform to AWWA C105. Film shall be Class C - Black, with a minimum nominal thickness of 0.008 inches (8 mils). Tape for securing the film shall be thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene. Tape shall have a minimum thickness of 8 mils, and a minimum width of 3 inch. The polyethylene film envelope shall be free as is commercially possible of gels, streaks, pinholes, particles of foreign matter, and undispersed raw materials. There shall be no other visible defect such as holes, tears, blisters or thinning out at folds. Manufacturers shall furnish a certification of compliance of the material to the requirement of AWWA C105.

**K. Marking Tape**

All PVC pipe shall be marked using a nonmetallic tape buried at least 15 inches above the top of the pipe. Water mains shall be marked with blue tape. Tape shall be 3 inches wide minimum and on the Board's list of materials and approved manufacturers. After the tracer wire has been placed, the pipe trench shall be backfilled to approximately 15 inches over the top of the pipe then the nonmetallic tape shall be placed flat over top of pipe within trench. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the tape is secured in place over the pipe. It is the intent to provide a visible marker in the event of excavation near a water line.

**ARTICLE 3 - TRENCHING**

All excavated material shall be placed in such a manner as not to endanger the work, and so that free access to all parts of the trench, fire alarm boxes, fire hydrants, where they exist, may be had at all times, and in such a manner as to inconvenience the public as little as possible. Reasonable and satisfactory provisions shall be made for travel on sidewalks, crosswalks, streets and private ways. No streets shall be closed to through traffic without the permission of the Owner or his agents. All drains, gutters, culverts and sewers for surface drainage shall be kept open, or if they are unavoidably closed, other provisions shall be made for this drainage. Trenches and open holes shall be properly protected from accidental entry.

The Contractor will be required to keep the sides of the trench as nearly vertical as possible by means of sheathing, bracing, etc., as may be required to thoroughly support the sides of the excavation, and to prevent any movement that might injure the main, diminish the width necessary for proper drainage, or otherwise injure or delay the work or seriously interfere with adjoining structures or operations. If sheathing is used, the bottom width of the trench in the clear shall be 12 inches wider than the greatest horizontal diameter of the water pipe. Unless otherwise ordered by the Engineer, that portion of sheathing in the trench extending below the top of the water main shall not be withdrawn before more than 6 inches of earth is placed above the top of the main. As the trench is backfilled, the sheathing and bracing shall be removed in such a manner as will avoid the caving in of the trench. The vacancy left by the sheathing shall be carefully filled. If the sheathing cannot be removed without injury to the water main or to the adjoining structures, it shall be left in place, or it shall be cut where directed and the upper part shall be removed.

The length of the trench to be opened or the area of surface to be disturbed and unrestored at any one time will be limited by the Engineer with regard to both expeditious construction and the convenience and comfort of persons residing in the neighborhood or frequenting the street in question. Unless authorized by the Engineer, there shall not be more than 200 feet of trench opened in advance of a section of completed water main, such completed section shall be a length of pipe which is in the process of being backfilled and/or tested and disinfected.

The Engineer reserves the right to control the length of trench opened in advance of pipe installation if, in his opinion, the laying, testing and disinfecting of pipe is not proceeding fast enough to complete the installation and backfilling within a reasonable length of time.

The Contractor shall furnish all labor and equipment necessary for pumping and shall pump or otherwise remove any water that shall be found or shall accumulate in the trenches. Trenches and other excavations shall be kept clear of water while pipe is being laid or concrete or masonry is being placed. No pipe or appurtenances shall be laid in water, and water shall not be allowed to flow over or rise up on any pipe until the work has been tested, disinfected and accepted.

The minimum cover over water lines 8 inches nominal diameter or less shall be 36 inches and for water lines 10 inches nominal diameter or greater, the minimal cover over the pipe shall be 48 inches, except where required to meet existing water lines. The bottom of the trench shall be excavated to a uniform grade and shall be free from obstruction which would result in the weight of the pipe being concentrated at certain points. The bottom of the trench shall be free from rocks, clods or other sharp-edged objects.

Where subsurface obstructions are encountered in the above trenching, the Contractor will be permitted to lay pipe above the obstruction if the minimum cover required can be obtained while providing a cushion at least 6 inches thick between the bottom of the pipe and the top of the obstruction.

Where the 6" minimum cover cannot be obtained above the obstruction, the Contractor will be required to lay pipe under the obstruction and he will receive no additional compensation for additional depth of bury will be paid constructing the line in this manner.

All landscaping, trees, telephone poles, power poles, etc., along the line of work shall be protected, and sufficient barricades, warning lights, etc., shall be provided for the protection of the public.

Where mains and laterals are to be laid beneath roadways, sidewalks, and driveways, the Contractor will not be permitted to cut and replace this pavement except where specified or in special cases where no other practical method for installation is available. With this exception, all mains and laterals under pavements shall be installed by means of a boring machine, auger, jack, or by other means satisfactory to the Engineer. In the event subsurface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks on either side of the pipeline, or is otherwise disturbed or broken due to the Contractor's operation, he shall repair or replace same at his own expense without further compensation.

Any necessary concrete and asphalt repairs should be made in accordance with the appropriate Section of Louisiana Standard Specifications for Road and Bridges 2016.

In excavating, backfilling and laying pipe, care shall be taken not to remove, disturb or injure other pipes, conduit or structures, without prior notice to the Engineer. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation, and within a reasonable time shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the Engineer at no additional cost to the Owner. All existing water line restraints disturbed by the Contractor shall be replaced at no additional cost to the Owner.

The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc., and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the execution of the work, the Contractor shall be responsible for any damage to persons or property caused by such breaks.

When pipe or conduits providing service to adjoining buildings are broken during the progress of the work, the Contractor shall repair them at once at his own expense, or if preferred by the utility involved, shall pay the utility the proper charges for having such repairs made by their own forces. Delays such as would result in buildings being without service overnight or for needlessly long periods during the day will not be tolerated, and the Owner reserves the right to make repairs at the Contractor's expense without prior notification. Should it become necessary to move a portion of a pipe, conduit or structure, it shall be done by the Contractor in strict accordance with instructions given by the Engineers or the utility involved.

**ARTICLE 4 - PIPE INSTALLATION**

Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

Where, in the opinion of the Engineer, the floor of the trench is not sufficiently stable to prevent vertical or lateral movement of the pipe after installation, the pipe shall be laid on a timber foundation or the trench shall be excavated below grade and brought back to grade with suitable filling of limestone or select fill material, as directed. There shall be no extra payment for pipe foundations filled with select fill material or limestone.

Immediately prior to placement of embedment materials, the bottoms and sidewalls of trenches shall be free of loose or unsuitable soil.

Thoroughly clean interior of pipe before lowering into the trench while keeping pipe interior free of foreign matter during laying operations.

When work is not in progress, the ends of the pipe and fittings shall be sealed so foreign material cannot enter pipe.

The pipe shall be installed and backfilled in accordance with the manufacturer's specifications. Items of work not mentioned specifically herein shall be performed in compliance with the current revision of AWWA C605, "Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water."

Pipe laying operations shall not block, obstruct, or prevent streams, ditches, canals, culverts, conduits, or gutters from carrying their normal flows or of serving their normal function without the approval of the Engineer. Any disruption shall be restored by the Contractor.

The trench shall provide continuous support for the pipe without voids or soft spots under the pipe.

Concrete thrust blocks shall be provided at all fittings where a change of direction occurs or as specified by the Engineer for all pipe three (3") in diameter or greater. Thrust blocks shall be poured against undisturbed soil and shall not cover the bolts or nuts on the fittings. A plastic barrier shall protect bolts or nuts from being covered. Concrete for thrust blocks and pads shall be 3000 psi at twenty eight (28) days. Concrete shall be ready mix; not Sakrete.

The water main shall be installed in steel casing where indicated in the Drawings, typically under state highways, railroads, or as indicated by the Engineer.

Pipe shall be laid beneath all ditches, sewers, culverts, pipes, conduits, drainage canals, tracks and similar structures. Regular pipe laying methods shall be used in all such cases except where special crossings are indicated.

The Contractor shall not operate any valves that will allow water to flow or stop the flow of water. These valves will be operated by the Owners personnel only.

Water service to customers shall be maintained without interruption as much as possible. Interruption of service shall be allowed only at times agreed to by the Owner and with proper notice to the customer (at least one hour in advance). Customers affected by permitted interruptions shall be notified by the Contractor.

The Owner may require that major connections which require lengthy interruptions to service be made during periods of low water use or that temporary service lines be provided by the Contractor at no additional cost to the Owner.

Assembly of fittings and other preparatory work shall be done in advance to reduce the off time and to keep interruption to a minimum.

**ARTICLE 5 - CROSSING OF STREAMS, CANALS, TRACKS**

The Owner will obtain necessary permit fees to cross canals, tracks, streams or waterways and shall pay any fees required. The Contractor shall comply with the conditions or restrictions of all such permits.

**ARTICLE 6 - BACKFILLING**

Perform backfill operations and restore surface as soon as practicable. Leave only the minimum length of trench open as necessary for construction.

Re-excavation of the trench for replacement of pipe, tapping, testing, or disinfecting shall be done by the Contractor at no additional cost to the Owner.

The Owner reserves the right to order any trench or trenches backfilled at any time after installation of pipe if the particular trench remaining open constitutes a public nuisance.

Outside of Public Right-of-Ways:

1. Compact excavated material around and to a depth of 12" above the pipe for the entire length of the trench to 90 percent of maximum standard proctor density in 6" to 8" lifts.
2. The remaining portion of the trench shall be backfilled in 12" lifts and thoroughly compacted leaving a slightly crowned condition, not to exceed 12" above natural ground.

Inside of Public Right-of-Ways: Outside of Public Roadways:

1. Compact excavated material around and to a depth of 12" above the pipe for the entire length of the trench to 95 percent of maximum standard proctor density in 6" to 8" lifts.
2. The remaining portion of the trench shall be backfilled in 12" lifts and thoroughly compacted leaving a slightly crowned condition, not to exceed 12" above natural ground.

Underneath roadways, streets, shoulders, walks, and drives (as per details in the drawings):

1. Limestone shall be compacted in 12" lifts to 95 percent density up to 3" (min.) –12" (max.) above pipe.
2. A mechanical vibrator shall be used to compact the limestone.
3. The remainder of the trench shall be filled with fill-crete (188 lbs. of cement, 3010 lbs. of sand, and 46.2 gals. of water).

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass, plots, etc., and the work area shall be left in a tidy and acceptable condition. The Contractor will not generally be required to regrass or seed lawns or neutral grounds where trenches are excavated in these locations unless specified otherwise. However, salvaging and replacement of sod on lawns may be ordered by the Engineer at no additional cost to the Owner. All surplus material shall be removed by the Contractor and shall be disposed of at locations and in a manner approved by the Engineer.

**ARTICLE 7 - SPECIAL BACKFILL**

Special backfill shall be used as directed by the Engineer where the excavated material is not suitable for backfilling the trench and obtaining the required compaction. Special backfill shall be soils conforming to DOTD Designation: TR 423, Class A-4, or better, with a maximum liquid limit of 35 and a maximum plasticity index of 15. The material shall be free from sod, weeds, grass and other objectionable matter. Sand will not be allowed for use as special backfill.

The special backfill material shall be compacted by approved methods to 100% of the density of the surrounding material determined in accordance with AASHTO Designation: T 99 (or to 95% of maximum density inside street right-of-way or servitude) unless specified otherwise.

**ARTICLE 8 - REPLACING STREET SURFACING AND SIDEWALKS**

In all paved or improved streets, the surface of the filled trenches (after the filling has dried and settled) shall, at the direction of the Engineer, be finished without any needless delay and in the best workmanlike manner with the same kind of roadway or sidewalk improvement that was removed in excavating the trench. The underlying foundation courses, as well as the finished surface, shall conform to the undisturbed portion of the roadway, or sidewalk, and shall in every respect be equal in quality, materials and workmanship. For this restoration, the Contractor will be paid the price bid per square yard for each class of

surfacing. Concrete driveways and parking areas must be saw cut, and restored to the same thickness as the existing surfacing or a minimum thickness of 6 inches, whichever is greater. A 6" x 6" x #6 wire mesh steel reinforcement shall be required for concrete drives and parking areas. Place reinforcement in the middle of the pavement.

Thickness of replaced sections of sidewalks shall be that of the existing thickness or a minimum four (4) inches, whichever is greater.

The decision of the Engineer shall be final as to the classifying of any form of pavement or surfacing not specified in the contract or of any forms where the classification is at all doubtful.

In bidding on repairs of pavement made up of two (2) or more courses, all the courses shall be considered as integral parts of the pavement; the price bid shall be for replacement of the pavement complete, including foundation, intermediate course (if present) and surface.

As soon as the roadway or sidewalk improvement which was disturbed by the Contractor has been replaced, all refuse or surplus materials deposited or left by the Contractor on the street shall be removed and the area shall be restored in all respects to as good a condition as before trenching was commenced.

No measurement of any pavement for payment will be made until the entire block or section is placed in proper condition and the above requirements are complied with.

Should the street or sidewalk surfacing, curbs, gutters, bridges, etc., outside the width measured for payment (as provided in paragraph above) be damaged, cracked, settled, disturbed or injured in any manner by the work, such damage or injury must be replaced and the surfacing, etc., restored to its former condition at no additional cost to the Owner.

Should the Contractor fail or refuse to repair any such damage, the Owner may, after twenty-four (24) hours written or verbal notice, employ such forces and furnish such materials as may be necessary and do the work, deducting the actual cost thereof from any amounts due or to become due to the Contractor.

#### **ARTICLE 9 - EXISTING STRUCTURES**

Existing structures shall be defined as all above and below ground structures, including all pipelines, poles, tracks, roads, culverts, sidewalks, drains, cables, wires, conduits, vaults, manholes, landscaping, and other appurtenant facilities, whether owned or operated by public bodies, private individuals, corporation, firms or companies.

Protect all existing structures from damage during construction.

Utility facilities shown on the plans are approximate locations (not scalable) and do not include service locations. There is no expressed or implied guarantee as to the accuracy of the various utilities or any omissions.

The Contractor shall verify the locations of all utilities and shall adhere to the provisions of OSHA 29 CFR 1926.651 at no cost to the Owner. Final project location will be determined in the field by the Engineer upon the Contractor's verification of all utilities.

In no case shall the Contractor receive additional compensation due to the location of existing utilities in relation to the final location of the proposed lines and appurtenances.

Notify all utilities or other interested parties prior to starting work and advise them of any adjustments required.

Contractor shall be responsible for investigating and informing himself of the condition, character and extent of all structures which may be encountered during construction.

Perform work in a manner to prevent interference with or damage to existing structures. Any damages done by the Contractor shall be his responsibility and all repairs shall be made immediately to the satisfaction of the Engineer.

The Owner and/or their agents shall not be responsible for any damages to or any costs incurred as a result of any delays due to existence, removal, adjustment or repair to any structures mentioned herein, shown on the plans or encountered during construction.

**ARTICLE 10 – FLUSHING OF WATER MAIN**

All water mains shall be flushed before testing and sampling the water system.

As-built information shall be provided to the Owner's personnel prior to any flushing and testing.

The flushing process shall be performed in the presence of the Owner's personnel. The Contractor shall notify Owner's personnel at least 48 hours prior to flushing of the water mains.

All water mains shall be flushed before testing and sampling of the water system.

Provide properly sized riser pipes for flushing when hydrant outlets are not convenient. Owner's personnel shall approve size of riser pipes for flushing.

The duration of the flushing shall be determined in the field by the Engineer.

The size of the flushing outlet shall be as shown below:

<u>Water Main Size</u>	<u>Size of Flushing Outlet</u>
2"	2" Riser
4"	2" Riser
6"	One 4 ½" Hydrant Pumper Outlet or One 6" Riser
8"	One 4 ½" Hydrant Pumper Outlet or One 6" Riser
10"	One 6" Riser
12"	One 8" Riser
16"	One 12" Riser

**ARTICLE 11 - TESTING**

Water for the test will be furnished by the Owner. The Contractor shall furnish all materials, equipment and labor to satisfactorily test the pipe at no cost to the Owner.

The water mains shall be pressured to 150 psi and hold that pressure for 2 hours.

**ARTICLE 12 - DISINFECTION**

All water lines and appurtenances shall be disinfected before placing in service.

Disinfection shall be performed in accordance with the latest revision of AWWA C651.

A solution of calcium hypochlorite, sodium hypochlorite, or liquid chlorine shall be used to obtain a solution of at least 50 mg/l of available chlorine throughout the entire piping system.

While the disinfectant is being applied to any section of the system, the water shall be allowed to flow at all extremities of the section until an orthotolidine test shows a deep orange color.

Allow the chlorine solution to remain in the pipe for minimum of 24 hours. Then tests shall be performed to determine that a chlorine residual of at least 5 mg/l remains in the system.

Repeat disinfection if chlorine residual is less than 5 mg/l.

Following disinfection, the lines shall be thoroughly flushed to remove the chlorine.

The Contractor shall be responsible to furnish taps, corporation stops, tubing, faucets, and labor to help obtain samples of water from the disinfected lines. These samples shall be collected and submitted to a biological laboratory of a State Certified Laboratory.

The disinfection process shall be made in the presence of Owner's personnel. The Contractor shall notify Owners Personnel at least 48 hours prior to testing of the water lines.

If bacteriological tests indicate that the water lines are not free of coliform organisms, the disinfection procedure shall be repeated on that part of the system until samples are proven to be free of contamination.

Disinfection shall be considered acceptable when reports indicate the lines are free of contamination and with the approval of the Engineer.

The Contractor will be responsible for removing all testing and flushing risers within 5 working days after notice of clear sample.

After all tests have been completed and risers removed, the corporation stops shall be plugged with a Mueller brass plug (No. H10033) or approved equal.

#### **ARTICLE 13 - GENERAL**

All work and materials required in the installation of the water mains shall be in compliance with specific requirements of these specifications. Any items of work not mentioned specifically herein shall be performed in compliance with the current revision of the equal AWWA regulation for the type pipe being used. Conform to applicable state and local codes for installation and testing of in this section. Provide minimum 6' horizontal clearance between water mains and sewer line running in parallel and 18" minimum vertical clearance at crossings.

#### **ARTICLE 14- COOPERATING WITH CITY UTILITIES**

The source of water shall be the public water supply system owned and operated by the Owner and operated by the Owner's Utilities System.

Connections to the system shall be made in accordance with the plans. The Contractor shall cooperate with the Water Superintendent of the Owner's Utilities System in scheduling work and making connections.

#### **ARTICLE 15 - STORAGE OF MATERIALS**

It shall be required that all pipe, fittings, valves and hydrants be stored in an appropriate stock yard upon receipt by the Contractor. Pipe, fittings, valves and hydrants shall be placed on the job site only as needed and not in quantities greater than those to be installed on one (1) working day. Pipe, fittings, valves and hydrants shall be stored in the yard and placed on the job site in such a way as to prevent flooding or the entrance of foreign and contaminating substances into the water line materials.

#### **ARTICLE 16 - UNIFORMITY OF FITTINGS**

The Contractor shall be responsible to assure that all mechanical joint fittings such as valves, fire hydrants, tees, crosses and bends be uniformly drilled so that all connections within the system shall fit.

#### **ARTICLE 17 - PUSH JOINT PLUGS**

The Contractor shall be responsible to assure that all pipe ends be plugged with a suitable push joint plug when construction of the water main is stopped for any length of time.

#### **ARTICLE 18 - FIRE HYDRANT BURY**

The fire hydrant bury shall be three (3'), four (4'), five (5') and six (6') feet unless specified in the bid form.

#### **ARTICLE 19 - CONCRETE BLOCKING**

The concrete blocking for valves, fittings, etc., shall be poured in such a manner as not to cover the bolts or nuts.

#### **ARTICLE 20 - CARE OF STREETS, SIDEWALKS, AND ROADS**

The Contractor shall be required, at his own expense, to remove all excess materials, debris or other obstruction from the streets or roads immediately after the backfilling has been completed. Wash the streets and sidewalks daily if necessary to remove the dust

problem. No cross streets, sidewalks or roads shall be wholly obstructed except by special permission from the Engineer. If at any time the Contractor neglects to remove such material or obstruction and place streets, sidewalks and roads in suitable condition for traffic within 24 hours after having received notice (written or verbal) from the Engineer, the work may be done by the Owner, and the cost thereof charged to the Contractor and deducted from his final estimate. The Contractor shall repair or replace streets, sidewalks, roads, and culverts to the satisfaction of the Engineer and parties concerned.

#### **ARTICLE 21 - PROTECTION AND CARE OF PUBLIC OR PRIVATE PROPERTY AND EASEMENTS**

The Contractor shall continuously maintain and protect all underground and above ground structures, utilities, including the restoration of all public utilities, water mains, water services, gas mains, gas services, culverts, drains, ditches, curbs, sidewalks, landscaping and/or other facilities which may be damaged, to a condition at least equal to their original status, at no additional cost to the Owner. In the event of damage to any facilities, the appropriate utility will be notified immediately. The Owner will repair damaged facilities at the Contractor's expense or require the Contractor to repair said damage.

All construction work under this contract on easements, right of way or franchise shall be confined to the limits of such easements, right of way or franchise. If work is required on private property the contractor will be required to obtain a right-of-entry from the property owner. All work shall be accomplished so as to cause the least amount of disturbance and a minimum amount of damage.

Prior to excavation on an easement or private right of way, and where required by the Engineer, the Contractor shall strip top soil from the trench or construction area and stockpile it in such a manner that it may be replaced by him, upon completion of construction. No trees or shrubbery shall be removed or trimmed without consent of the Engineer. Ornamental trees and shrubbery shall be carefully removed, with the earth surrounding their roots wrapped in burlap and replanted in their original positions with 48 hours. All shrubbery or trees destroyed or damaged shall be replaced by the Contractor with material of equal quality at no additional cost to the Owner. In the event that it is necessary to trench through any lawn areas, the sod shall be carefully cut, rolled and replaced after the trenches have been backfilled, the backfilling and compacting to be as described for surfaced areas. The lawn area shall then be cleaned, by sweeping or other means, of all earth and debris.

All obstacles such as fences, markers, mail boxes, driveway culverts, etc., shall be removed by the Contractor and immediately replaced after trench is backfilled in their original position and condition at no direct cost to the owner. The Contractor shall notify the Engineer and property Owner at least 24 hours in advance of any work done on easements or right-of-ways.

It is expressly understood that the Contractor shall restore all easements and right of ways to a condition equal to their original condition, and in a condition satisfactory to the property owners and the Engineers.

The Contractor shall maintain adequate drainage during the process of construction. Performance of this work is not payable directly, but shall be considered as a subsidiary obligation of the Contractor, covered under the contract price for the construction items.

All trees, stumps, slashing, brush, excess soil, waste, rubbish, or other debris removed from the sites as a preliminary to the construction work or during construction, shall be removed from the property and disposed of in a manner and a location that complies with local ordinances and laws acceptable to all parties concerned and is approved by the Engineer.

When disposal of excess soil is upon private lands, the contractor shall be required to produce a written agreement with the private land owner stating the agreed terms and conditions.

#### **ARTICLE 22 - MAINTENANCE OF TRAFFIC AND COMMUNICATIONS**

Refer to Louisiana Department of Transportation Temporary Traffic Control Specifications and Special Details, "The Work Area Traffic Control Handbook" (for Lafayette City-Parish streets), and US Department of Transportation Federal Highway Administration "Manual on Uniform Traffic Control Devices" Part VI, Traffic Controls for Streets and Highway Construction and Maintenance Operations.

The Contractor shall conduct his operations in such a manner so that interference with public travel and inconvenience to the public and to property owners will be minimized. Operations shall be so conducted as to cause minimum interference with access to the property on the streets under construction. The Contractor shall provide and maintain, at his own expense, suitable bridges, detours or other temporary facilities for the accommodation of public or private travel, as directed by the Engineer. Twenty-four-hour notice to owners of private driveways shall be given prior to interfering with them. Maintenance of traffic may be curtailed providing that the Contractor shall obtain permission from the owner or tenants of private property, or proper public authority, or both, to obstruct traffic within the said limits and time agreed upon. The Contractor shall notify the Engineer immediately of any

such agreement. The Contractor shall keep the local fire protection authorities informed at all times of the location of construction operations and fire lanes and shall maintain access for firefighting equipment as requested by the Fire Department. One-way traffic shall be maintained on all streets during construction, except where suitable detours or other arrangements are agreed to. A flagman (flagmen) shall be provided as required in this section. Upon completion of backfilling of all excavations in roadways and streets, the Contractor shall have a motorized rubber wheel road grader on the job site. This grader shall be used to maintain all streets and roadways in a satisfactory condition approved by the Engineer for the duration of the contract.

The Contractor shall have someone available to take calls at all times. He shall provide the Owner and the Engineer with a night telephone number to call so that he may be advised of any emergency, trouble or other matter requiring his attention.

#### **ARTICLE 23 – TEMPORARY TRAFFIC CONTROL**

The Contractor shall furnish Temporary Traffic Control in accordance Section 713 Temporary Traffic Control of Louisiana Standard Specifications for Roads and Bridges 2016 Edition and Manual on Uniform Traffic Control Devices (MUTCD).

#### **ARTICLE 24 - PAYMENT**

##### **A. WATER MAINS**

The basis of measurement and payment for installing water mains shall be the linear foot of water main of the various sizes and types actually installed excluding water main that is required to complete other items of work which have been defined in the bid. Measurement shall be from center line of fitting or appurtenance to center line of fitting or appurtenance.

A fire hydrant lead (pipe required in addition to typical hydrant installation) shall be paid for as water mains.

Payment for water mains, measured as provided above, will be at the contract unit price per linear foot for "(Size) Water Mains (Type Specified)" and shall constitute full compensation for furnishing all material, including all appurtenances, not specifically provided for elsewhere in the specifications, and furnishing all labor, equipment and appliances necessary for unloading, hauling, installing, testing, disinfecting the lines, excavating, trenching, sheathing, shoring, bracing, pipe foundation, backfilling, and disposition of surplus excavated material, all as hereinbefore set forth in these specifications and as provided for on the plans. No direct payment will be made for polyethylene encasement of ductile iron pipe, fittings and appurtenances when required on the construction plans.

##### **B. RESTRAINED JOINT DUCTILE IRON WATER MAINS**

The basis of measurement and payment for installing restrained joint ductile iron water mains shall be the linear foot of water main of the various sizes and types actually installed excluding water main that is required to complete other items of work which have been defined in the bid. Measurement shall be from center line of fitting or appurtenance to center line of fitting or appurtenance.

Payment for restrained joint water mains, measured as provided above, will be at the contract unit price per linear foot for "(Size) Restrained Joint Ductile Iron Water Main" and shall constitute full compensation for furnishing all material, including all appurtenances, not specifically provided for elsewhere in the specifications. No direct payment will be made for polyethylene encasement of ductile iron pipe, fittings and appurtenances when required on the construction plans.

##### **C. JACKING OR BORING**

The basis of measurement shall be by the linear foot and shall be the actual center line length of pipe so installed as measured from the vertical cut nearest to and on each side of the obstruction to be bored but shall not exceed 2 feet beyond the obstruction. The vertical cut nearest to and on each side of the obstruction shall be approved by the Engineer. Jacking and boring operations shall in no way interfere with the operation of railroads, streets, highways, or other facilities and shall not weaken or damage such facilities. Jacking or boring HDPE pipe quantity shall include adapters, reducers and fittings necessary to tie-in HDPE pipe to PVC Pipe.

Payment for jacking or boring water mains will be at the unit price bid for furnishing and laying pipe as stated in Paragraph A above, plus the price bid as extra for installing pipe by the jacking and/or boring method, which shall be full compensation for furnishing all materials, labor, tools, equipment, excavation, sheathing, shoring, backfilling, hauling, unloading, testing, disposition of surplus excavation, and incidentals necessary to complete work.

Payment for jacking or boring casing pipe will be at the unit price bid for furnishing and installing casing pipe as stated in Paragraph D below, plus the price bid as extra for installing the casing by the jacking and/or boring method, which shall be full compensation for furnishing all materials, labor, tools, equipment, excavation, sheathing, shoring, backfill, hauling, unloading, testing, disposition of surplus excavated material, and incidentals necessary to complete work.

In the event sub-surface operations result in injury or damage to the pavement, repairs to this pavement shall be made by the Contractor at no additional cost to the Owner. In the event paving cracks are caused on either side of the pipe line, or should the paving be otherwise disturbed or broken due to the Contractor's operation, he shall repair or replace same to its original condition or better at no additional cost to the Owner.

#### **D. CASING PIPE**

The basis of measurement shall be by the linear foot and shall be the actual center line of casing so installed.

Payment for casing so installed will be at the unit price bid for furnishing and installing the casing pipe. Water mains laid in the casing shall be paid for as stated in Paragraph A above. No direct payment will be made for casing spacers installed around the carrier pipe in the casing.

#### **E. REPLACEMENT OF STREET, DRIVEWAY AND SIDEWALK SURFACING**

Measurement of removal and replacement of street, highway, driveway, and sidewalk pavement, when ordered by the Engineer, shall be determined by multiplying the length of trench cutting the pavement by the width of the pavement replaced, except that the pay width shall not exceed the sum of the diameter of the pipe plus 2 feet.

Separate payment shall be made for gravel, shell or limestone surfacing unless specified otherwise.

Payment for removal and replacement of highway, street and sidewalk paving shall be paid for by the unit price bid per square yard and by the cubic yard for limestone. The payment shall constitute full compensation for removal of existing paving, backfill, compaction, subgrade preparation, finishing and curing, temporary planking and surfacing; for furnishing and hauling and installing all materials for a permanent surface repair; and for furnishing equipment, tools, labor, supervision and other incidentals necessary to complete this item in accordance with these specifications and as shown on the plans. The unit price shall also include saw cutting of the street, highway, driveway, and sidewalk pavement and base with a concrete saw so that a neat, straight joint shall be exposed after the repair is complete. Replacing damaged culverts under streets, highways, driveways, or sidewalks shall be included in this unit price. The concrete finish on the driveway or sidewalk shall be as directed by the Engineer.

#### **F. SPECIAL BACKFILL**

Measurement for special backfill for foundation or for backfill over pipe shall be based on the theoretical in place volume in cubic yards obtained by multiplying the width of the trench by the length and by the depth less 2 feet. The maximum pay width shall be 3 feet which is the maximum trench width shown on the detail on the plans. Payment for special backfill shall be by the cubic yard in place at the contract unit price for "Special Backfill" and shall constitute full compensation for furnishing, hauling, placing and compacting the backfill and removal of the excavated material and disposing of it.

#### **G. AGGREGATE FOR MAINTENANCE**

Measurement of limestone for maintenance during construction for final dress up of street and driveway shall be by the cubic yard, truck measure, and placed as ordered by the Engineer. Measurement for limestone shall be by the cubic, vehicular measurement.

Payment for shell shall be at the unit price bid for "(Type) Aggregate for Maintenance", or "(Type) Aggregate for Streets and Driveways" and shall constitute full compensation for furnishing, hauling, stockpiling, placing, and compacting the Aggregate. Payment shall constitute full compensation for furnishing, hauling, stockpiling, placing, and compacting the aggregate. Where the contract does not provide a separate item for shell for streets and driveways, but does provide an item for shell for maintenance, the final dress-up of streets and driveways, shall be paid for at the contract unit price for "(Type) Aggregate for Maintenance". The Contractor will not be paid for aggregate used for maintenance unless truck tickets are furnished to the Engineer. This payment shall be on a "one time basis" subsequent additional aggregate due to subsidence of trench etc. shall be performed at no direct pay.

**H. STREAM CROSSINGS**

Measurement of stream crossing shall be per each for the limits designated on the water details.

Payment of typical offset shall be per each for as stipulated on the Contract Documents and shall constitute full compensation for furnishing all labor, material, equipment, tools and other incidentals necessary for removal of any existing pipe, any new pipe, fittings, zinc coated all thread rods, deadman assembly, unloading, hauling, installing, testing, disinfecting the lines, excavating, trenching, sheathing, shoring, bracing, pipe foundation, backfilling, disposition of surplus excavated material, and other incidentals necessary to complete this item as shown on the plans.

**I. TYPICAL OFFSET**

Measurement of typical offset shall be per each for the limits designated on the water details.

Payment of typical offset shall be per each for as stipulated on the Contract Documents and shall constitute full compensation for furnishing all labor, material, equipment, tools and other incidentals necessary for removal of any existing pipe, any new pipe, fittings, zinc coated all thread rods, deadman assembly, unloading, hauling, installing, testing, disinfecting the lines, excavating, trenching, sheathing, shoring, bracing, pipe foundation, backfilling, disposition of surplus excavated material, and other incidentals necessary to complete this item as shown on the plans.

**J. TIE-IN TO EXISTING MAINS**

Connections to existing mains will be paid for per each, and includes full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the connection. Valves and fittings are measured and paid for under other items. This item will provide payment for connections to existing mains where tapping sleeves and tapping valves are not paid for separately.

Connections to existing mains will be measured by the actual count of each connection according to type and size installed, tested, sterilized and accepted. These connections will be paid for at the contract unit price per each, which price and payment shall constitute full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the item in accordance with plans and specifications.

**K. WATER MAIN REMOVAL**

The basis of measurement and payment for removing water mains shall be the linear foot of water main of the various sizes and types actually removed excluding water main removal that is required to complete other items of work which have been defined in the bid. Measurement shall be from center line of fitting or appurtenance to center line of fitting or appurtenance.

Payment for water main removal, measured as provided above, will be at the contract unit price per linear foot for "(Size) Water Main Removal (Type Specified)" and shall constitute full compensation for excavation, removal and disposal of water main and fittings, furnishing, hauling, placing and compacting backfill, labor, tools and equipment, supervision, and all incidentals necessary to complete this work.

**L. CASING REMOVAL**

The basis of measurement and payment for removing casing shall be the linear foot of casing of the various sizes and types actually removed. Measurement shall be along center line of casing.

Payment for casing removal, measured as provided above, will be at the contract unit price per linear foot for "Casing Removal (Type Specified)" and shall constitute full compensation for excavation, removal and disposal of casing and apparatuses, furnishing, hauling, placing and compacting backfill, labor, tools and equipment, supervision, and all incidentals necessary to complete this work.

**M. GROUTING OF PIPES**

The basis of measurement and payment for grouting abandoned pipes shall be by the linear foot of abandoned-in-place pipe. Measurement shall be along the center line of pipe.

Payment for grouting abandoned pipes shall be full compensation for labor, equipment, materials and incidentals required to mix, transport and place the grout and restore surface at pump ports. The unit price shall include plugs and installation of temporary pumping and venting ports as required to provide complete filling of the abandoned line and proper placement of the grout. Any damage resulting from the pumping operation shall be repaired at the contractor's expense.

**ARTICLE 26 - TYPICAL ITEMS FOR PAYMENT**

ITEM	UNIT
(Size & Type) Water Main	Linear Foot
(Size) Restrained Joint Ductile Iron Water Main	Linear Foot
Jack or Bore (Size) Water Main	Linear Foot
Jack or Bore (Size) Steel Casing	Linear Foot
(Size) Casing	Linear Foot
Remove and Replace (Type Surface)	Square Yard
Special Backfill	Cubic Yard
(Type) Aggregate for Maintenance	Cubic Yard
(Size) (Type) Stream Crossing	Each
Size) (Type) Typical Offset	Each
Tie-In to Existing Mains (Size) (Type)	Each
(Size) (Type) Water Main Removal	Linear Foot
Casing Removal (Size) (Type)	Linear Foot
Grouting of Pipes	Linear Foot

**TECHNICAL SPECIFICATIONS  
FOR  
WATER DISTRIBUTION SYSTEM**

**8.2 VALVES, HYDRANTS, FITTINGS AND SERVICES**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all labor, equipment, appliances and all materials and in performing all operations in connection with the installation of valves, hydrants, fittings and services complete and in place, in accordance with the specifications and contract drawings.

**ARTICLE 2 – MATERIALS**

Furnish fire hydrants, service pipe and valves that have homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. A certificate of compliance from the manufacturer stating products meet standards as set forth in these specifications will be required for each item.

**A. GATE VALVES AND VALVE BOXES**

The gate valves to be supplied under this contract shall be mechanical joint gate valves (4 inch thru 12 inch) having a resilient seat and shall conform to AWWA Specification C509 or C515 and UL/FM approved.

Design of gate valves four (4") inch through twelve (12") inch shall provide non-rising stem (NRS), dual seal between gate and body, smooth closing gate and one piece cast iron wedge with integral lugs. Valve shall be furnished with standard o-ring seals, two o-ring seals shall be set above the stem thrust collar and one below. Direction to open shall be counter-clockwise equivalent to American Flow 2500, M&H 4067-01 or 7571, Clow F6100 (C509 or C515) or Mueller A-2360.

Makes and models shall be approved by the Engineer.

Valves for use with 2 inch pipe shall be AWWA non-rising stem, iron body, bronze mounted, double-disk gate valves, similar to the type specified for larger sizes, except that the joints shall be screwed ends.

Valves shall be provided with 2 inch operating nuts marked to indicate the direction of opening. Valves shall be opened counterclockwise.

Valve boxes for all valves of 12 inch diameter and smaller shall be made of cast iron and shall be of the heavy roadway type with inside diameter of not less than 5 inches. The top section shall be adjustable for elevation. The base shall be sufficiently enlarged so that it will not come in contact with the valve or pipe at any point. All valve boxes shall be provided with covers on which the word "WATER" is printed in raised letters. A pre-cast concrete pad shall be installed for all valve boxes outside of pavement.

Gate valves larger than 12 inch nominal diameter shall be approved by the Engineer.

**B. FIRE HYDRANTS**

The fire hydrants to be supplied under this contract shall conform to AWWA Standard C 502-94 or updated revisions thereof for improved type three-way hydrants dry barrel type hydrants. All hydrants must be UL and FM approved. All hydrants shall contain the following features:

1. Operating nut must be:
  - a. Bronze.
  - b. Non-rising, pentagonal in shape, measuring 1-1/2" from point to flat.
2. Hold-down nut must:
  - a. Incorporate an integral resilient weather seal.
  - b. Must be: counterclockwise.
3. Lubrication chamber must be provided:
  - a. Sealed top and bottom with "O" rings.
  - b. Filled with lubricant which shall be either oil or grease.

- c. The design shall be such that the thrust collar and the threaded operating parts are automatically lubricated each time the hydrant is cycled.
- d. There must not be less than two (2) "O" rings separating the lubrications reservoir from the waterway and that portion of the stem contracting these "O" rings shall be sleeved with bronze.
  - e. An anti-friction device must be in place above the trust collar to further minimize operating torque.
4. Hydrants bonnet – must be attached to the upper barrel by not less than four (4) bolts and nuts, with an inserted flat rubber gasket as a pressure seal.
5. Hydrants must be:
  - a. "Three-way", having two (2) 2-1/2" hose nozzles with National Standards Threads and one (1) pumper nozzle measuring 4-1/2" I.D. with National Standard Thread.
  - b. Nozzles must attach counterclockwise into hydrant barrel utilizing "O" ring pressure seals.
  - c. A suitable nozzle lock must be in place to prevent inadvertent nozzle removal.
  - d. "Traffic-model", having upper and lower barrels joined approximately 2" above the ground line by a separated and breakable "swivel" flange providing 360 degree rotation of upper barrel for proper nozzle facing. This flange must employ not less than eight (8) bolts.
- e. Stem must be: two-piece, not less than 1-1/4" diameter or 1" x 1" square (excluding threaded or machined areas) and must be connected by a breakable stem coupling near the ground line flange. Screws, pins, bolts or fasteners used in conjunction with the stem coupling must be stainless steel.
  - f. Painted with Yellow Enamel #54-302 PPG or equal on exterior.
6. Hydrant shoe and barrel casting must be fabricated of ASTM, A-126, Class B Gray Iron or Ductile Iron ASTM, A1-536, but no combination thereof, assuring uniform strength of all cast components, minimizing the possibility of shoe breakage upon traffic impact. The inside diameter of the hydrant barrel shall not be less than six and one-eighth inches (6-1/8).
7. Main valves must be:
  - a. Compression type closing with the pressure and must be not less than 5-1/4" diameter.
  - b. Composition of the main valve must be molded rubber or neoprene, having a durometer hardness of 95 (+) (-) 5 and must be not less than 1" thick.
8. Hydrants must be equipped with drain valves which drain the barrel when the hydrant is closed and seal shut when the hydrant is open.
9. Seat ring and drain ring (show bushing) must be:
  - a. Bronze (ASTM B-62) and work in conjunction to form an all bronze drain way.
  - b. Two (2) drain openings are required and if they are in the cast iron shoe, they must be bronze lined and the bronze seat ring must thread into bronze drain ring (or shoe bushing) providing bronze to bronze connection.
  - c. Seat ring seals must be "O" rings. The 6" shoe connection must be specified (flanged, A/C, M.J., etc.) having ample blocking for sturdy setting and a minimum of eight (8) bolts and nuts is required to fasten the shoe to the lower barrel.
  - d. The interior of the shoe shall have a protective coating of a two-part thermosetting epoxy of at least 4 mils. If a stem cap nut is utilized it must be locked in place by a stainless steel lock washer or similar non-corrosive device.
10. Hydrant must have:
  - a. A working pressure rating of 250 PSIG and be tested at 500 PSIG.
  - b. Have a manufacturer's warranty against defects in material or workmanship for a period of (5) years from date of manufacture.
11. Upon request, supplier must furnish flow data indicating friction loss in PSI at the flow of 1,000 GPM from the pumper nozzle. Such friction loss must not exceed 3 PSI.
12. Hydrant bury shall be three (3'), four (4'), five (5') and six (6') feet unless specified in bid form.
13. Hydrant extension sections shall be furnished by the same manufacturer as for the hydrant to which section is to be added.
14. One (1) hydrant extension shall be furnished with each ten (10) hydrants or fraction thereof.
15. All nozzle caps shall have extra long, heavy (no smaller than five (5) gauge) link chains that will not kink. The chain loop at the cap end shall permit free turning of the caps.
16. Couplings:
  - a. Anchor couplings or swivel hydrant fittings shall be used where indicated on the drawings or where required by the Engineer to tie six (6") inch pipe from the main to the hydrant.
  - b. The three (3) types of anchoring fittings available are- anchoring tees, anchoring elbows and anchoring couplings.
  - c. Swivel mechanical joint hydrant fittings shall be made with AWWA Class "D" metal thickness throughout, with applicable dimensions, laying lengths and radii, conforming to AWWA A21.10 and AWWA C-111.
  - d. All anchoring tees shall be six (6") inch by six (6") inch by six (6") inch MJ by MJ by Swivel.

- e. All anchoring elbows shall be six (6") inch by six (6") inch Swivel by Swivel ninety (90<sup>0</sup>) degree elbow.
- f. All anchoring couplings shall be six (6") inch by six (6") inch Swivel by solid adapter twelve (12") long.
- g. Acceptable manufacturers of anchor couplings: Tyler Pipe and Foundry Company, U.S. Pipe and Foundry Company, James B. Clow and Sons or approved equal.

The hydrants to be supplied under this contract shall be Mueller A-423 "Centurion", M & H Dresser 929 "Reliant", Kennedy K-81 "Guardian", Clow F2545 Medallion, American B-84-B, or approved equal.

### C. FITTINGS

#### DUCTILE IRON

Mechanical joint fittings shall be manufactured in accordance with the latest edition of ANSI A21.10/AWWA C110 for standard body or ANSI A21.53/AWWA C153 for compact body and shall be ductile iron. The rated working pressure shall be 350 PSI. Sufficient quantities of gaskets, glands, bolts and nuts shall be furnished to provide for each socket opening. Bolts and nuts shall be alloy steel (Corten Type). All fittings shall be asphalt coated outside and cement lined and seal coated inside in accordance with ANSI A21.4/AWWA C104. Fittings must be manufactured in the United States

### D. JOINT RESTRAINT DEVICES

Where required on the construction plans or directed by the Engineer, mechanical joint fittings and pipe joints shall be restrained. Fittings used with ductile iron pipe will be required to use ductile iron retainer glands (UFR 1400 Ford Restrainer, or approved equal) in lieu of the standard glands. Retainer glands shall be installed in accordance with the manufacturer's requirements.

All fittings used in conjunction with PVC pipe shall be mechanical joint fittings restrained using the UFR 1500 Ford Restrainer Gland, or approved equal.

Ductile iron pipe joints designated to be restrained shall be ductile iron mechanical joint pipe with mechanical joint retainer glands as described in this section. No additional payment will be made for the use of mechanical joint ductile iron pipe.

PVC pipe and ductile iron pipe joints 12 inches in diameter and smaller designated to be restrained shall be restrained by a UFR 1390 Ford Restrainer, or approved equal.

### E. TAPPING SLEEVES AND VALVES

Mechanical joint type cast iron tapping sleeves and valves shall be used where indicated on the drawings or where required by the Engineer to make connections to existing 4 inch and larger water mains. Tapping sleeves shall be 304 stainless steel with stainless steel flange, bolts, and nuts as manufactured by Mueller H-304SS, Romac SST, Smith Blair 663, and Ford Fast, or approved equal. The tapping valves shall have a resilient seat and shall conform to AWWA Specifications C509 or C515. Tapping valves manufactures shall be Kennedy, Clow, M&H, American Flow, Mueller or approved equal.

### F. CUT-IN SLEEVES AND VALVES

Cut-in valves shall be furnished with mechanical joints. Cut-in sleeves shall be Mueller H-842, or approved equal. Cut-in valves shall be equal to gate valves specified hereinabove, Mueller Number H-866, or approved equal. A valve box shall be furnished and installed with each cut-in valve.

### G. SERVICE CONNECTIONS

#### 1. High Density Polyethylene Tubing

All high density polyethylene plastic tubing shall be SDR 9, Class 250 PSI, PE 4710 (Cell Class 445576-c) and conform to ASTM D 3350, the latest amendment thereof. Stainless steel inserts (liners) are required on all connections to pack joint fittings.

**2. Corporation Stops**

All corporation stops used shall conform to AWWA Standard C800 and shall be Ford Number F-1000, or approved equal, and shall be of the size indicated in the detail drawing.

**3. Curb Stops**

Curb stops shall not be used unless such use is specifically requested and is approved by the Water Division. If required, these shall conform to AWWA standards and shall be Ford ball valves, or approved equal, and shall be of the size required.

**4. Meter Boxes**

Cast iron meter boxes shall be sized by the Water Division and shall be of the following types, or approved equal:

SIZE OF CONNECTIONS		METER SIZE	TYPE
INLET	OUTLET		
1"	1"	5/8" x 3/4"	Ford Yokebox Number YL 244-244
1"	1"	1"	Ford Number 4 Yokebox
2"	2"	1-1/2" x 2"	1/4" Cast Iron Box with 1/4" Steel Floor Plate Cover (Per Plan Detail)

Meter boxes for meters up to and including 1 inch shall have pack joint fittings on each inlet and outlet connection and shall be coated with a coal tar type paint except for the lids which shall be painted Grass Green with the words "WATER METER" imprinted on them.

**5. Check Valves**

All services 1 inch shall be provided with a Stockham B-345 bronze check valve, or approved equal. Check valves less than 1 inch shall be used when determined by the Water Division as necessary.

**6. Service Fittings**

Brass goods and fittings shall be made of red brass of composition 85-5-5-5. All threads shall be standard in accordance with AWWA Standard C800 for service fittings and shall be manufactured by recognized manufacturers.

Pack joints for joining galvanized pipe, K copper and polyethylene plastic tube PE 3408 shall be Ford pack joint couplings, or approved equal.

**7. Customer Shut-Off Valve**

The customer shut-off valve shall be a gate valve type, Mueller H 10914, Nibco T-22, or approved equal. Body shall be of waterworks brass, tapped and threaded for iron pipe. Valves shall be a positive stop to prevent flow.

**8. Service Saddle Clamps**

The service saddle clamps shall be Ford all brass or approved equal for 2 inch lines and Ford double strap Model F-202 or approved equal for 4 inch lines and larger.

**H. THREADED RODS**

Threaded rods shall be low carbon steel, electro-galvanized zinc plated and have a minimum diameter of 3/4". Accessories shall be provided to anchor rods to fittings and water lines.

**ARTICLE 3 - INSTALLATION OF VALVES AND FITTINGS**

Valves and fittings shall be placed in locations shown on the plans or at locations designed by the Engineer. All water valves shall be set vertically, unless otherwise directed by the Engineer. Thrust blocks shall be provided at each change of direction of flow and shall be adequate to prevent displacement. Installation of valves and fittings shall conform to the typical detail drawings, or in accordance with manufacturer's instructions. A concrete foundation shall be provided for each valve. Any omission of these appurtenances shall be corrected by the Contractor without additional cost to the Owner.

Before being placed in the trench, all valves and fittings shall be carefully examined by the Contractor to assure that they are in good working order.

Over each valve shall be placed a cast iron valve box having its cover level with the surface of the ground, or finished street grade, or to the elevation specified by the Engineer. The weight of the valve box shall not be supported by the valve or piping.

**ARTICLE 4 - INSTALLATION OF FIRE HYDRANTS**

Hydrants shall be placed with pumper nozzles facing the street and shall be located as indicated on the contract drawings. Each hydrant shall be placed on a concrete base and shall be secured against dislocation, as indicated on the typical detail drawings. A minimum of 7 cubic feet of clean washed gravel shall be placed around each hydrant base. Backfill above gravel shall be thoroughly tamped.

Hydrants of the required bury shall be used at each location and each shall be buried to the point indicated on the barrel. Cutting or filling around the hydrant will be required as may be necessary to meet existing grades or proposed grades. Where necessary, and where required by the Engineer, hydrant extension sections shall be installed to adjust the hydrant to grade.

Hydrant shall be placed plumb and with back side at the right-of-way line, unless otherwise directed by the Engineer. Hydrants shall be properly lubricated and shall be in good working order before acceptance. Touch-up painting will be required prior to acceptance.

Fire hydrant leads (pipe required in addition to typical hydrant installation) will be classed as mains and will be paid for as such. Valves shall be located at the main line tee.

**ARTICLE 5 - PAYMENT****A. VALVES AND VALVE BOXES**

Payment for valves and valve boxes shall be based on the actual number installed and shall be paid for at the contract price per each for the various size valves and valve boxes, such price to cover both valve and valve box, and any necessary joint adapters for fitting the valves into the system.

Such payment shall constitute full compensation for furnishing the valves and valve boxes and for all labor, equipment, tools and supplies necessary for installation of the valves and valve boxes in accordance with these specifications and the drawings.

**B. PAYMENT FOR NEW FIRE HYDRANTS**

Payment for hydrants shall be based on the actual number installed and shall be paid for at the contract unit price per each for "New Fire Hydrant (Type)". Such payment shall be full compensation for furnishing the fire hydrants and anchor fittings as described in these specifications and as shown on the plans and for all labor, equipment, tools, materials and supplies necessary for installing the fire hydrants in accordance with these specifications and as shown on the drawings.

Payment for vertical fire hydrant extensions shall be based on the vertical foot actually installed. Payment shall be made at the contract unit price per vertical foot for "Vertical Hydrant Extension" and shall constitute full compensation for furnishing all materials, tools, labor, equipment, supervision and incidentals necessary to complete the installation.

Payment for hydrant leads (pipe required in addition to typical hydrant installation) shall be in accordance with payment for installation of water mains. Valves between hydrants and mains are not to be considered as part of the hydrant installation and shall be paid for in accordance with payment for valves and valve boxes.

### **C. FITTINGS**

#### **1. Ductile Iron Mechanical Joint**

Ductile Iron Mechanical Joint Water Main Fittings installed with water lines shall be measured by the ton, based on the catalog weight per fitting and the numbers of each type of fitting actually supplied, installed, tested, disinfected and accepted. The weights of the fittings shall be exclusive of bolts, nuts, gaskets, glands when a restrainer is used, and all accessories. All fittings not specifically listed separately on the Bid Form shall be included in this measurement and payment.

Payment shall be based on the number of tons actually installed and shall be made at the price bid per ton. Payment shall include full compensation for labor, materials, supplies, thrust blocks, anchors, equipment, tools and incidentals necessary for completely installing the fittings in accordance with these specifications and the contract drawings. No direct payment will be made for fittings for pipe 3 inches in diameter and smaller.

### **D. JOINT RESTRAINT DEVICES**

Measurement of joint restraint devices shall be per each installed on existing pipe. Payment shall be made at the contract unit price for "(Size) Joint Restraint" and shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary to complete this item of work. No separate payment will be made for installation of restrainer glands and bell joint restraints on installation of new fittings and pipe.

### **E. TAPPING SLEEVES AND VALVES**

Measurement of tapping sleeves and valves shall be based on the number of each size actually installed, and payment shall be at the unit price bid per each.

Payment shall constitute full compensation for furnishing the sleeves and valves, valves, valve boxes, the labor, equipment, tools, materials, supplies, thrust blocks, anchors and other incidentals necessary for complete installation in accordance with these specifications and the contract drawings.

### **F. CUT-IN SLEEVES AND VALVES**

Measurement of cut-in sleeves and valves shall be based on number of each size actually installed and payment shall be at the unit price bid per each.

Payment shall constitute full compensation for furnishing of the sleeves and valves, valve boxes, the labor, equipment, tools, materials, supplies, thrust blocks, anchors and other incidentals necessary for complete installation in accordance with these specifications and the contract drawings.

### **G. SERVICE CONNECTIONS**

#### **1. Polyethylene Tubing**

Polyethylene tubing shall be paid for at the unit price per foot at the price bid for the various sizes by the linear foot actually installed accepted.

Payment shall constitute full compensation for furnishing polyethylene tubing, labor, equipment, tools, material, supplies and other incidentals necessary for complete installation in accordance with these specifications and contract drawings.

#### **2. Corporation Stops**

No direct payment will be made for furnishing and installing corporation stops.

**3. Service Connections**

Service connections shall be paid for at the unit price per each as bid for the various sizes and types specified. Measurement shall be the quantities actually installed as described in the Bid Form and on the plans.

Payment shall constitute full compensation for furnishing all labor, equipment, tools and incidentals necessary to complete the work.

**H. ADJUSTING SERVICE LINES TO GRADE**

Measurement will be by the linear feet of adjusting service lines to grade, including valves, fittings, meters, boxes and other appurtenances. Measurement will be made from end to end of adjusted service line.

Payment shall be per linear foot of adjusting service lines to grade, and constitute full compensation furnishing all labor, equipment, tools, material, supplies and other incidentals necessary to lower or raise service line, including valves, pipe, fittings, meters, boxes, and other appurtenances in accordance with these specifications and contract drawings.

**I. RELOCATING FIRE HYDRANTS, WATER VALVES AND WATER METERS**

Existing fire hydrants, water valves and water meters will be measured by the number of each relocated, including relocation of boxes for such valves and meters.

Payment for fire hydrant relocation shall be per each, and constitute full compensation for excavation and backfill, furnishing all labor, equipment, tools, material, supplies and other incidentals necessary to relocated fire hydrant which includes crushed stone drain.

Payment for water valve and water meter relocation shall be per each, and constitute full compensation for excavation and backfill, furnishing all labor, equipment, tools, material, supplies and other incidentals necessary to relocate water meter (including box) and water valves (including box) in accordance with these specifications and contract drawings.

**J. ADJUSTING HOUSE CONNECTIONS**

Adjusting house connections shall be measured by the number of house connections adjusted.

Payment for adjusting house connections shall be per each, and constitute full compensation for excavation and backfill, furnishing all labor, equipment, tools, material, supplies and other incidentals necessary for adjustment of service line not exceeding 20 linear feet and required new pipe and fittings.

**K. ADJUSTING METER BOXES AND VALVE BOXES**

Existing meter boxes and valve boxes adjusted to grade in their original locations will be measured by the number adjusted.

Payment for adjusting meter boxes and valve boxes shall be per each, and constitute full compensation for excavation and backfill, furnishing all labor, equipment, tools, material, supplies and other incidentals necessary to adjust meter boxes and valve boxes to grade in accordance with these specifications and contract drawings.

**L. REMOVAL OF WATER VALVES AND FIRE HYDRANT**

Existing water valves, including boxes when necessary and fire hydrants, including all associated fittings and leads will be measured by the number of each removed.

Payment for removal of water valves and fire hydrants shall be per each, and , and constitute full compensation for excavation and backfill, furnishing all labor, equipment, tools, material, supplies and other incidentals necessary for removal of water valves and fire hydrants in accordance with these specifications and contract drawings.

**ARTICLE 6 - TYPICAL ITEMS FOR PAYMENT**

ITEM	UNIT
(Size) (Type) Valve and Box	Each
Fire Hydrants (Type)	Each
Vertical Hydrant Extension	Linear Foot
D.I.M.J. Fittings	Ton
(Size) Joint Restraint	Each
(Size) Tapping Sleeve, Valve and Box	Each
(Size) Cut-In Sleeve, Valve and Box	Each
(Size) (Type) Tubing	Linear Foot
(Type) Service Connections	Each
Adjusting Service Lines (Size & Type)	Linear Foot
Relocating Fire Hydrants	Each
Relocating Water Valves	Each
Relocating Water Meter	Each
Adjust House Connections	Each
Adjust Meter Boxes	Each
Adjust Valve Boxes	Each
Remove Fire Hydrants	Each
Remove Water Valves Including Box	Each

**TECHNICAL SPECIFICATIONS  
FOR  
MISCELLANEOUS CONCRETE WORKS**

**ARTICLE 1 - SCOPE OF WORK**

This work consists of the construction of concrete sidewalks, driveways, parking areas, curbs and gutters, small slabs, headwalls, embedment for posts, foundations for light standards and sign structures and other miscellaneous formed and unformed concrete in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions shown on the plans or established by the Engineer.

**ARTICLE 2 - MATERIALS**

**A. PORTLAND CEMENT CONCRETE**

The concrete shall have a minimum compressive strength at twenty-eight (28) days as shown on the plans when tested in accordance with DOTD Designation: TR 230. Concrete shall have a minimum compressive strength of 3,500 psi unless otherwise specified on the plans. Portland cement shall comply with the standard specifications for Portland cement and shall be Type 1.

**B. PREFORMED JOINT FILLERS**

Prefomed joint fillers shall be used in joints when specified in accordance with the project and specifications. Unless otherwise specified, the Contractor has the option of using any of these approved preformed fillers. Other preformed fillers may be approved by the Engineer and specified in the project plans or specifications.

**1. Bituminous Type Prefomed Joint Filler**

Bituminous preformed expansion joint filler shall consist of bituminous (asphalt or tar) mastic composition, formed and encased between two (2) layers of bituminous impregnated felt. The preformed filler shall conform to ASTM Designation: D 994.

**2. Redwood Joint Filler**

The boards shall be clear heart redwood. Occasional medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended. No board of a length less than 6 feet may be used and the separate pieces shall be held securely to form a straight line. When a section of less than 6 feet is required, no spliced board will be accepted.

The dimensions shall be as specified and a tolerance of +1/16 inch thickness, +1/8 inch depth, and ±1/4 inch length will be permitted.

The load required to compress the material in an oven-dry condition to 50% of its original thickness shall not exceed 1,800 psi.

**3. Prefomed Closed Cell Polyethylene Joint Filler**

The joint filler shall be formed by the expansion of polyethylene base resin, extruded as a multicellular, closed cell, homogeneous section of foamed polyethylene. This material shall be used with an adhesive as recommended by the manufacturer. The joint filler and adhesive shall be approved products on the DOTD Qualified Products List. The dimensional requirements for the joint filler shall be as shown on the plans.

**4. Prefomed Galvanized Keyed Joint Forms**

The joint form shall be galvanized steel of the dimensions and thickness indicated on the plans or directed by the Engineer. The form shall be shaped such that it forms a tongue and groove joint. The form shall be of sufficient strength to resist the pressure of the concrete without springing.

### C. POURED JOINT SEALERS

These joint sealers shall be used in sealing joints when specified in accordance with the project plans and specifications. If not specified, the Contractor may use any of the poured joint sealers in Section 1005.02 of the DOTD Standard Specifications for Roads and Bridges. Other sealants may be approved by the Engineer and specified in the project plans or specifications.

### D. REINFORCING STEEL

Reinforcing steel for concrete reinforcement shall conform to the following specifications:

1. Billet-Steel Deformed and Plain Bars, ASTM Designation: A 615
2. Rail-Steel Deformed and Plain Bars, ASTM Designation: A 996
3. Axle-Steel Deformed and Plain Bars, ASTM Designation: A 996
4. Cold-Drawn Steel Wire, ASTM Designation: A 1064, with the following amendment: For material testing over 110,000 psi tensile strength in high strength applications such as spirals and ties, the 25% minimum reduction in area shall be reduced 5% for each 10,000 minimum psi increment of tensile strength exceeding 110,000 psi
5. Welded Steel Wire Fabric, ASTM Designation: A 1064
6. Number 2 bars need not be deformed and shall conform to Headings 1, 2 or 3 above. Wire conforming to Heading 4 above may be used in lieu of Number 2 bars when furnished in Size W 5

### E. CURING MATERIALS

Curing materials shall conform to the following:

#### 1. Liquid Membrane - Forming Compounds

This material shall conform to AASHTO Designation: M 148, and shall be an approved product listed in the LA DOTD Approved Material List. The types shall be Type 2 white-pigmented, or Type 1-D clear or translucent with a fugitive dye, as specified.

#### 2. Burlap Cloth Made from Jute or Kenaf

This material shall conform to AASHTO Designation: M 182, Class 3.

#### 3. Waterproof Paper

This material shall conform to AASHTO Designation: M 171.

#### 4. White Polyethylene Sheeting

This material shall conform to AASHTO Designation: M 171.

#### 5. Combined Burlap and White Polyethylene Sheeting

These materials shall conform to AASHTO Designation: M 171.

## ARTICLE 3 - FORMED CONCRETE

Formed concrete shall include those items of construction which are constructed of reinforced concrete and have specified size, shape and dimensions, such as concrete headwalls, slabs and others as shown in the plans or specified by the Engineer. Formed concrete shall be constructed in accordance with these specifications.

Reinforcing steel shall be bent to the shapes shown on the plans. All steel reinforcement shall be placed as near as practicable to the position shown on the plans and firmly held in place during placing of the concrete. When placed in the structure, reinforcing steel shall be free from dirt, base rust, loose scale, paint, oil, grease or other foreign material.

Splices of reinforcement shall be staggered as far as possible. Unless shown otherwise on the plans, bars shall be lapped a minimum of 30 bar diameters. Construction joints shall not be made within the limits of the lapped bars.

**ARTICLE 4 - UNFORMED CONCRETE**

When shown on the plans or specified by the Engineer, unformed concrete shall be used for splash aprons, concrete collars and for other uses other than for patching. The concrete shall have a compressive strength of 3,500 psi at twenty-eight (28) days and shall be unreinforced.

**ARTICLE 5 - EXCAVATION AND BACKFILL**

Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm, even surface conforming to the section shown on the plans. All soft and yielding material shall be removed and replaced with approved material, at the Contractor's expense, and thoroughly compacted.

Backfill shall be of approved material free of grass, weeds and other objectionable material. The backfill material shall be spread in successive layers not exceeding 8 inches loose depth and shall be compacted by an approved method of 95% maximum density, determined in accordance with DOTD Designation: TR 418. When subsurface drainage structures are to be placed under parking areas, curb and gutter, sidewalks, driveways or other formed concrete, the excavation and backfilling for them shall be completed and compacted before the subgrade is prepared as specified herein.

Excavation and backfill will not be measured as a separate item, but shall be considered as incidental to the work.

**ARTICLE 6 - FORMS**

Forms shall be of wood or metal and shall extend for the full depth of concrete. All forms shall be straight, clean, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 1/2 inch from the face of the structure without damage to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 1/4 inch from the face of the concrete with chisels or nippers; for green concrete, nippers are necessary. Fittings for metal ties shall be of such design that, upon their removal, cavities which are left will be of the smallest possible size. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in color. For curbs, a mechanical curb forming machine may be used.

**ARTICLE 7 - JOINTS****A. CURBS AND GUTTERS**

Joints shall be formed in integral curbing to correspond with transverse joints in the pavement slab. All joints shall extend entirely under the curb and gutter section and through the curb and gutter and shall be finished and filled with prescribed filler.

All other types of curbing shall be provided with 1/2 inch expansion joints at all drainage structures and at the beginning and end of all curves; the maximum distance between expansion joints shall not exceed 200 feet. Premolded joint filler shall be placed through the entire cross section of the curb and gutter at all expansion joints. Dummy joints shall be formed at intervals of 15 feet. Dummy joints shall be approximately 1/4 inch wide and shall extend into the concrete for at least 1/4 of the depth.

**B. SIDEWALKS AND DRIVEWAYS**

Expansion joints shall be of the dimensions specified and shall be filled with a preformed expansion joint filler. Dummy joints shall be formed with a jointing tool or by other acceptable means as directed. The dummy joints shall extend into the concrete for at least 1/4 of the depth and shall be approximately 1/8 inch wide.

Unless otherwise specified, the spacing of dummy joints for sidewalks shall be equal to the width of the walk but not less than 4 feet. A longitudinal dummy joint shall be formed along the centerline of driveways more than 16 feet wide and transverse dummy joints shall be formed in driveways at not more than 16 foot intervals.

Construction joints shall be formed around all appurtenances such as manholes, etc., extending into and through the paving. Unless otherwise specified, 1/2 inch preformed expansion joint filler shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete paving and any fixed structure such as a building or bridge. The expansion joint filler shall extend for the full depth of the paving.

Expansion joint filler for sidewalks shall be 1/2 inch thick and shall be placed at intervals not exceeding 28 feet and at all junctions of new concrete with curbs, existing walks and driveways.

### **C. PARKING AREAS**

Contraction joints shall be placed in concrete parking areas at intervals not to exceed 15 feet in length or width. The joints shall be tongue and groove joints, formed with a preformed galvanized keyed joint form as specified in Article 2, Paragraph B4 of this section. All construction joints shall be contraction joints except around fixed objects. At all fixed objects, such as buildings, construction joints shall be formed and 1/2 inch preformed joint filler shall be placed in these joints unless otherwise specified. The joint filler shall extend for the full depth of paving. Expansion joints shall be formed as specified and shall be filled with a preformed expansion joint filler.

### **ARTICLE 8 - DEPOSITING CONCRETE**

The subgrade shall be thoroughly moistened immediately prior to placing concrete. The concrete shall be placed on the prepared subgrade, struck-off and compacted to the required thickness. All concrete shall be spaded or vibrated sufficiently to eliminate all voids and shall be tamped to bring the mortar to the surface. The surface shall be finished smooth and even with a wooden float. All edges shall be rounded with an approved finishing tool.

For integral type curbing, after the pavement has been struck-off, the curb form shall be clamped or otherwise securely fastened in place on the slab form and the additional concrete shall then be deposited and thoroughly tamped. The additional concrete shall be placed within thirty (30) minutes after the pavement slab has been finished and care shall be taken to ensure monolithic construction. The Contractor shall then proceed in accordance with these specifications.

At the Contractor's option, integral type curbing may be placed after completion of the pavement, provided dowels are placed in the pavement of the size, type and spacing shown on the plans. No additional cost to the Owner shall result from placing curb by this method.

At the Contractor's option, concrete curbing may be placed by slip-form methods. Slip-formed concrete shall be placed with an approved machine designed to spread, vibrate, consolidate and finish the concrete in one (1) pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense, homogeneous unit. The sliding forms shall be rigidly held together to prevent spreading of forms, and after passing there shall be no noticeable slumping of concrete. The concrete shall be held at uniform consistency with a 1/2 inch to 2 inch slump unless directed otherwise by the Engineer.

### **ARTICLE 9 - FINISHING**

Forms on curbing shall be removed within twenty-four (24) hours after the concrete has been placed and honeycombed areas and other defects shall be filled with a mortar composed of Portland cement and sand, mixed in the same proportion as provided for the concrete. Plastering will not be permitted on the faces of curbs and all rejected concrete shall be removed and replaced without additional compensation.

On parking areas, sidewalks and driveways, the forms shall remain in place for at least twenty-four (24) hours after placement of the concrete. Defective areas shall be filled in with a mortar composed of Portland cement and sand, mixed in the same proportions as provided for the concrete. The surface of sidewalks and driveways shall be finally brushed in order to leave a slightly rough finish. Joints and edges shall be rounded with an edging tool having a 1/4" radius.

The forms shall remain in place for seven (7) days on formed concrete. Defective areas shall be corrected as specified for curb and gutter, sidewalks and driveways.

When a rubbed finish is specified, completed concrete shall be finished by rubbing the exposed surfaces with carborundum or other abrasive to a smooth surface and to remove all form marks. Non-exposed surfaces shall have the form finish, except that all holes and defects shall be corrected.

**ARTICLE 10 - CURING**

Concrete shall be cured for at least seventy-two (72) hours. Curing shall be done with the use of white pigmented liquid membrane curing compound or by other approved methods. During the curing period, traffic detrimental to the structure shall not be permitted.

**ARTICLE 11 - COLD WEATHER CONCRETING**

Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40 degrees Fahrenheit, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 degrees Fahrenheit provided the high temperature forecasted by the National Weather Service is above 40 degrees Fahrenheit and remains above 32 degrees Fahrenheit for a minimum of 24 hours. Concrete shall not be placed if the US National Weather Service forecast the temperature to be less than 35 degrees Fahrenheit within 24 hours period following placement unless authorized in writing.

If the air temperature is 35 degrees or less at the time of placing concrete, the Engineer may require the water or the aggregates to be heated to not less than 70 degrees Fahrenheit nor more than 150 degrees Fahrenheit. After placement, the concrete shall be protected by additional covering, insulating materials, or other methods approved by the Engineer. No concrete shall be placed on a frozen subgrade nor shall frozen aggregates be used in the concrete.

**ARTICLE 12 - REMOVE AND REPLACE CONCRETE SIDEWALKS AND DRIVEWAYS**

The Contractor shall remove sidewalks and driveways where designated on the plans by making a neat sawed joint. The removed concrete shall be disposed of as directed by the Engineer.

The sidewalk or driveway shall be replaced to match the finish grade to the original width and thickness. However, in no event shall it be less than 4 inches thick.

Construction of sidewalks and driveways shall conform to this section of the specifications. Wire mesh fabric reinforcing shall be required only where original concrete sidewalks and driveways were reinforced.

**ARTICLE 13 - SAWED JOINTS**

Where required on the plans or directed by the Engineer, the Contractor shall remove pavement, drives and walks by making a neat sawed joint. All work shall be performed with an approved saw and blade. The minimum depth of the saw cut shall be 2 inches unless specified otherwise with 0.125 inches minimum width. Damage to pavement surface designated to remain shall be repaired by the Contractor at no cost to the Owner.

**ARTICLE 14 - MEASUREMENT AND PAYMENT****A. SIDEWALKS AND DRIVEWAYS**

Portland cement concrete sidewalks and driveways shall be measured by the square yard, complete and in place. Payment shall be at the unit price bid per square yard for "Concrete Sidewalk (Thickness, Type)" or "Concrete Driveway (Thickness, Type)" and shall be full compensation for furnishing all labor, materials, equipment, tools, excavation and backfill, reinforcing steel, joint materials, and incidentals required to complete the work.

**B. CURBS AND GUTTERS**

Portland cement concrete curbs and gutter shall be measured by the linear foot measured along the line shown on the plans, complete and in place. Payment shall be at the price bid per linear foot for "Curb and Gutter (Size, Type)" or "Concrete Curb (Size, Type)" and shall constitute full compensation for supplying all labor, equipment, tools, materials, excavation and backfill, reinforcing steel, joint materials, and incidentals necessary to complete this item of work.

**C. FORMED CONCRETE**

The cubic yards of completed formed concrete in place, as calculated from the dimensions shown on the drawings or ordered by the Engineer, shall be paid for at the contract unit price per cubic yard for "Formed Concrete". Such payment shall constitute full compensation for all labor, equipment, tools, materials and supplies necessary to complete these items

of work. All reinforcement required will not be measured separately, but should be included in price bid.

#### **D. PARKING AREAS**

Portland cement parking areas shall be measured by the square yard, complete and in place. Payment shall be at the unit price bid per square yard for "Concrete Parking (Thickness)" and shall be full compensation for furnishing the required labor, materials, equipment, tools, excavation and backfill, reinforcing steel, joint materials, and incidentals for completing the work.

#### **E. UNFORMED CONCRETE**

The cubic yards of unformed concrete, complete and in place, as determined from field measurements by the Engineer, shall be paid at the contract price per cubic yard for "Unformed Concrete". Such payment shall be considered full compensation for furnishing all labor, equipment, materials, supplies and incidentals necessary to complete the work.

#### **F. REMOVE AND REPLACE CONCRETE SIDEWALKS AND DRIVEWAYS**

This item shall be measured by the square yard, complete and in place. Payment shall be at the contract price per square yard for "Remove and Replace Concrete Sidewalks and Driveways" and shall be full compensation for all labor, materials, equipment, tools, supplies and incidentals necessary to do this item of work.

#### **G. SAWED JOINTS**

Sawed joints shall be measured on a linear foot basis. Payment shall be at the contract price per linear foot for "Sawed Joints" and shall be full compensation for all labor, materials, equipment, tools, supplies and incidentals necessary to complete the work. When the contract does not contain a pay item for "Sawed Joints", this work will be considered incidental to the work and will not be measured for payment.

#### **ARTICLE 15 - TYPICAL ITEMS FOR PAYMENT**

<b>ITEM</b>	<b>UNIT</b>
Concrete Sidewalk (Thickness, Type)	Square Yard
Concrete Driveway (Thickness, Type)	Square Yard
Curb and Gutter (Size, Type)	Linear Foot
Formed Concrete	Cubic Yard
Remove and Replace Concrete Sidewalks and Driveways	Square Yard
Concrete Parking (Thickness, Type)	Square Yard
Concrete Curb (Size, Type)	Linear Foot
Sawed Joints	Linear Foot

**TECHNICAL SPECIFICATIONS  
FOR  
CULVERTS AND STORM DRAINS**

**ARTICLE 1 - SCOPE OF WORK**

This work shall consist of furnishing and installing culverts, and storm drainage pipe, also referred to as conduit, in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

**ARTICLE 2 - MATERIALS**

**A. CONCRETE PIPE**

Concrete pipe shall be non-reinforced concrete pipe and shall conform to the requirements of ASTM Designation C-14. Joints shall conform to Section D of this article.

**B. REINFORCED CONCRETE PIPE**

Reinforced concrete pipe shall conform to the requirements of ASTM Designation C76. Circular reinforcement rather than elliptical reinforcement shall be used in all concrete pipe. Reinforced concrete pipe shall conform to the following:

1. Unless otherwise specified, Class III pipe, Wall B shall be furnished.
2. When extra strength pipe is required, either Class IV or Class V Reinforced Concrete Pipe shall be furnished as specified. Either Wall A, B, or C may be furnished.
3. The pipe shall be tested for permeability as specified in ASTM Designation C497.
4. The absorption test specified in ASTM Designation C76 will be conducted if the pipe exhibits visual porosity.
5. For pipe sizes not included in ASTM Designation C76, the area of reinforcement shall be approved in accordance with ASTM Designation C655
6. No modified designs will be allowed.
7. Joints shall conform to Section D of this article.

**C. REINFORCED CONCRETE PIPE ARCH**

Reinforced concrete pipe arch shall conform to ASTM Designation C506, amended as follows:

1. Unless otherwise specified, Class III pipe arch shall be furnished.
2. No modified designs will be allowed.
3. Basis of acceptance is expanded to include the following: Random testing, as established by the Engineer, will be made to assure proper placement of reinforcement.
4. For pipe arch sizes not included in ASTM Designation C506, the area of reinforcement shall be approved in accordance with ASTM Designation C655. The producer shall provide fabrication drawings reflecting conformance to these specifications prior to pipe inspection.
5. Joints shall conform to Section D of this article.

**D. CONCRETE PIPE JOINTS**

Joints for concrete pipe and pipe arch shall conform to AASHTO Designation M198 with the following modifications. Gasket material shall conform to Section L of this article.

**1. Type 3 Joints**

- a. Pipe for Type 3 joints shall have a maximum taper of 12° and a maximum differential between the joint taper of the bell and the spigot (tongue and groove) of 1° with the following exception. A maximum allowable differential between the tongue and groove may be 2° provided the taper is 6° or less and it will pass the 10 psi hydrostatic pressure test. The 10 psi hydrostatic test requirement will apply to pipe with diameters greater than 15" when the groove (bell) depth or tongue (spigot) length is less than 2-1/2", and will apply to pipe with diameters of 15" or less when the groove depth or tongue length is less than 2".
- b. Joints for use with rubber gaskets which have a taper less than 6° will not require hydrostatic pressure test except as provided in Paragraph (a) above. If the joint taper is 6° to 8°, its use will be permitted provided the joint will pass the 10 psi hydrostatic pressure test.
- c. Joints for use with flexible plastic gaskets which have a taper less than 10° will not require the hydrostatic pressure test except as provided in Paragraph (a). If the joint taper is 10° to 12°, its use will be permitted provided the joint will pass the 10 psi hydrostatic pressure test.

**2. Type 2 Joints**

Pipe for Type 2 joints shall have joints qualified by the DOTD Materials Section, shall use approved rubber or flexible plastic gaskets and shall pass the 5 psi hydrostatic pressure test.

**3. Type 1 Joints**

Pipe for Type 1 joints shall have joints qualified by the DOTD Materials Section and shall use approved rubber or flexible plastic gaskets.

**4. Repair of Joints**

Joint repairs shall conform to ASTM Designation C443.

**E. CORRUGATED STEEL PIPE AND PIPE ARCH**

Corrugated steel pipe and pipe arch shall conform to the requirements of Type I (culvert pipes, circular section) and Type II (culvert pipes, other than circular section) of AASHTO Designation M36 amended as follows:

1. Pipe and pipe arch shall be galvanized (zinc coated) in accordance with AASHTO Designation M218.
2. Elbows, tees, and other in-line fittings shall be fabricated from sheets of the same thickness and coating material as the pipe or pipe arch to which they are joined. Flared end sections shall be as specified.
3. Shop-formed elliptical pipe and shop-strutted pipe shall be furnished when specified.
4. When smooth-lined pipe is specified, the inside circumference of the pipe shall be fully lined with bituminous material in accordance with AASHTO Designation M190, Type D.
5. Helical pipe shall have annular ends and shall have the ends of seams welded a minimum of 2". Helical pipe ends shall be re-rolled a minimum of two (2) full standard corrugations.
6. Pipe arch dimensions shall conform to the latest DOTD standard dimensions.
7. Pipe joints for metal pipe arch shall conform to Section K of this article and shall be as shown on the plans.

8. A minimum of two (2) approved lifting lugs shall be provided on pipe larger than 30" diameter and pipe arch larger than 30" equivalent diameter.
9. All welds and damaged zinc coatings shall be repaired by an approved method with a cold galvanizing repair compound listed on the DOTD Qualified Products List.

#### **F. BITUMINOUS COATED CORRUGATED STEEL PIPE AND PIPE ARCH**

Bituminous coated corrugated steel pipe and pipe arch shall conform to AASHTO Designation M190 amended as follows:

1. AASHTO Designation M36 is amended in accordance with Section E above.
2. The coating shall be Type A, fully bituminous coated unless otherwise specified.
3. Pipe joints shall conform to Section K of this article.

#### **G. ASBESTOS BONDED CORRUGATED STEEL PIPE AND PIPE ARCH**

Asbestos bonded corrugated steel pipe and pipe arch shall be fabricated from asbestos bonded steel sheets. The base metal and the fabrication of conduits and connecting bands shall conform to Section E.

The steel sheets shall be coated on both sides with a layer of asbestos fibers applied by pressing a sheet of asbestos fiber into the molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly impregnated with a bituminous saturant. The finished sheets shall be of the first class commercial quality, free from blisters, unsaturated spots, or other defects.

After fabrication, the asbestos bonded pipe and pipe arch shall be fully bituminous coated with Type A coating in accordance with AASHTO Designation M190. Smooth lined and paved invert pipe shall be coated in accordance with Section E above.

Asbestos bonded corrugated steel pipe and pipe arch shall be fabricated by the riveting process.

#### **H. CORRUGATED ALUMINUM PIPE AND PIPE ARCH**

Corrugated aluminum pipe and pipe arch shall conform to AASHTO Designation M196, with the following exceptions:

1. Helical pipe shall have annular ends and shall have the ends of seams welded a minimum of 2". Helical pipe ends shall be re-rolled a minimum of two (2) full standard corrugations.
2. Pipe Arch Dimensions shall conform to the latest DOTD standard dimensions.
3. Pipe joints shall conform to Section K of this article and shall be as shown on the plans.
4. A minimum of two (2) approved lifting lugs shall be provided on pipe larger than 30" diameter and pipe arch larger than 30" equivalent diameter.

#### **I. POLYMERIC COATED CORRUGATED STEEL PIPE AND PIPE ARCH**

These conduits shall conform to the requirements of Type 1 (culvert pipes, circular section) and Type 2 (culvert pipes, other than circular section) of AASHTO Designation M245 amended as follows:

1. Pipe and pipe arch shall be galvanized (zinc coated) in accordance with AASHTO Designation M218.
2. Polymeric coated pipe fabrication shall only be allowed with helical lock seam pipe.
3. Thickness of polymeric coating on the finished pipe shall be 0.010" on the interior and exterior surfaces.
4. Helical pipe shall have annular ends and shall have the ends of the seams welded a minimum of 2 inches. Helical pipe ends shall be rerolled a minimum of two (2) full standard corrugations.

5. Pipe Arch Dimensions shall conform to the latest DOTD standard dimensions for metal pipe arch.
6. Pipe joints shall conform to Section K of this article and shall be as shown on the plans.
7. Polymeric coated steel and approved repair materials shall be from a source listed on the DOTD Qualified Products List.
8. A minimum of two (2) approved lifting lugs shall be provided on pipe larger than 30" diameter and pipe arch larger than 30" equivalent diameter.
9. All welds and damaged zinc coating shall be repaired by an approved method with a cold galvanizing compound listed on the DOTD Qualified Products List. Exposed edges and damaged polymeric coating shall be repaired with an approved material to a minimum thickness of 0.010".
10. Elbows, tees, and other in-line fittings shall be fabricated from sheets of the same thickness and coating material as the pipe or pipe arch to which they are joined. Flared end sections shall be as specified.

#### **J. STRUCTURAL PLATE PIPE AND PIPE ARCH**

Structural plate pipe and pipe arch shall conform to AASHTO Designation M167.

Aluminum alloy structural plate pipe and pipe arch shall conform to AASHTO Designation M219.

#### **K. METAL PIPE JOINTS**

Coupling bands for joining metal conduit shall conform to AASHTO Designation M36 for steel conduit and AASHTO Designation M196 for aluminum conduit with the following modifications:

##### **1. Coupling Bands**

Bands shall be of an approved design and shall be fabricated from metal sheets of the same material as the conduit. The band thickness shall be the same as the conduit thickness with a maximum of 12 gage. Coating shall be the same as used on the conduit. Minimum band width shall be 12" wide for conduit less than 36" in diameter (or arch equivalent) and 24" wide for conduit 36" in diameter (or arch equivalent) and greater.

##### **2. Rubber Gaskets**

Rubber gaskets shall conform to Section L. Gasket cross section shall be as shown on the plans or directed by the Engineer.

##### **3. Flexible Plastic Gaskets**

Flexible plastic gaskets shall conform to Section L. Gasket material shall be a minimum of 1" for 1/2" corrugation depth, and a minimum of 1-1/2" for 1" corrugation depth.

##### **4. Hardware**

Hardware shall be galvanized in accordance with ASTM Designation A153 or B633, Class Fe/Zn 25 or an approved mechanical galvanizing process that provided the same coating thickness.

##### **5. Steel Banding Rods**

Steel banding rods shall conform to ASTM Designation A36. Welding of rods will not be permitted. No more than two (2) splices will be allowed.

##### **6. Angle and Strap Connections**

Angle and strap connections shall be approved by the DOTD Materials Section.

**7. Type 3 Joints**

These joints must pass the 10 psi hydrostatic pressure test before being approved. Joint details shall be as shown on the plans or directed by the Engineer.

**8. Type 2 Joints**

These joints must pass the 5 psi hydrostatic pressure test before being approved. Joint details shall be as shown on the plans or directed by the Engineer.

**9. Type 1 Joints**

These joints shall be a Type 2 or 3 joint or other approved joint system. At least one (1) line of approved gasket material will be required under the band on each pipe end.

**L. JOINT MATERIALS**

Joint materials for conduit shall conform to the following:

**1. Rubber Gaskets**

Rubber gaskets for pipe joints shall conform to AASHTO Designation M198, Type A. Each pipe manufacturer or supplier shall furnish certificates of analysis certifying that the gaskets conform to the above specification. The lubricant shall be the type recommended by the gasket manufacturer.

**2. Flexible Plastic Gaskets**

Flexible plastic gaskets for pipe joints shall conform to AASHTO Designation M198, Type B. Flexible plastic gasket material and primer shall be from a source on the DOTD Qualified Products List.

**M. METAL PIPE GAGE**

Metal pipe shall have a minimum sheet thickness (gage) as specified on the plans or in the project specifications. If the sheet thickness (gage) is not specified, the minimum sheet thickness (gage) shall conform to the latest version of DOTD Standard Plan SAM-1.

**N. CORRUGATED METAL PIPE OR CORRUGATED METAL PIPE ARCH**

When the item "Corrugated Metal Pipe" or "Corrugated Metal Pipe Arch" is included in the contract, the Contractor shall have the option of furnishing conduit of bituminous coated corrugated steel, asbestos bonded corrugated steel, corrugated aluminum or polymeric coated corrugated steel, unless otherwise specified.

**O. CULVERT PIPE AND CULVERT PIPE ARCH**

When the item "Culvert Pipe" or "Culvert Pipe Arch" is included in the contract, the Contractor shall have the option of furnishing conduit of reinforced concrete, asbestos bonded corrugated steel, bituminous coated corrugated steel, corrugated aluminum or polymeric coated corrugated steel, unless otherwise specified.

**P. PIPE CONDUIT AND PIPE ARCH CONDUIT**

When the item "Pipe Conduit" or "Pipe Arch Conduit" is included in the contract, the Contractor shall have the option of furnishing reinforced concrete pipe of the size specified or the specified size of corrugated metal pipe in accordance with Paragraph N above.

**Q. GRANULAR MATERIAL**

Granular material shall be non-plastic, having clean, hard, durable, siliceous grains; and when tested in accordance with DOTD Designations TR112 and TR113, shall meet the following gradation requirements:

U. S. SIEVE	PERCENT PASSING (BY WEIGHT)
1/2"	100
No. 10	75 - 100
No. 200	0 - 15

**R. PLASTIC FILTER CLOTH**

The plastic filter cloth shall be a pervious sheet of plastic yarn. The fabric shall be an approved product on the DOTD Qualified Products List for pipe joints.

**ARTICLE 3 - ALIGNMENT AND GRADE**

Prior to excavation, an offset line of hubs parallel to the conduit centerline shall be set by the Engineer, unless specified otherwise. Offset hubs shall be set at every drainage structure and at 100' intervals. Cuts to the invert of the conduit and offsets from the centerline of the conduit shall be computed and recorded on a cut sheet for the Contractor's use in installing the conduit. The Contractor shall be responsible for establishing the centerline of the conduit from the hubs placed.

The Contractor shall be required to provide a transit with tripod, range pole, level with tripod and level rod on the job site at all times. All equipment shall be in good condition as determined by the Engineer.

If a laser is used to establish vertical and horizontal alignment of the conduit, the Contractor shall set the laser beam on exact horizontal and vertical alignment of the centerline of the conduit prior to laying the conduit. The laser equipment shall be in good condition and the acceptability of these items of equipment shall be subject to approval of the Engineer.

The Contractor shall notify the Engineer at least 48 hours prior to commencing trenching operations.

**ARTICLE 4 - TRENCHING**

The Contractor shall perform trench excavation of whatever substance encountered to the depths indicated on the plans. Proper enlargements shall be made at each bell to distribute the load to the barrel of the pipe. Muck or other unsuitable material shall be removed and replaced with suitable material as ordered by the Engineer at no extra cost to the Owner.

The trench shall be excavated so that the walls are as nearly vertical as possible to a minimum width which will provide working room to obtain specified compaction. Where required to safeguard employees or adjacent structures, the sides of the trench shall be properly sheathed and braced.

Where, in the opinion of the Engineer, damage is liable to result from withdrawing the sheathing, the sheathing will be required to be left in place.

Any water accumulated in the trenches shall be removed at no additional cost to the Owner prior to laying pipe. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner, a sufficient distance from the edge of the excavation to avoid overloading and to prevent slides or cave-in. Trenching shall not be more than 200' ahead of pipe laying.

**ARTICLE 5 - PIPE LAYING**

All pipe shall be carefully laid to the lines and grades as shown on the plans or specified by the Engineer.

Branch openings or service connections provided for future extensions shall be plugged with a precast concrete plug and joint material specified herein shall be used to make a watertight joint.

Any pipe which is not true in alignment or which shows settlement after laying, shall be taken up and relaid at the Contractor's expense.

The interior of culvert pipe shall be kept clear of debris as the work progresses.

All tongue and groove joints shall be laid with the groove up grade.

All lifting holes in concrete pipe shall be sealed with precast concrete plugs, and joint material conforming to Article 2, Section L, Paragraph 2, shall be used to make the seal water tight.

## **ARTICLE 6 - JOINING CONDUIT**

### **A. TYPES OF JOINTS**

Type 3 joints shall be used on all storm drainage systems.

### **B. CONCRETE CONDUIT**

Concrete conduit may be either bell and spigot, or tongue and groove. The method of joining conduit sections shall be such that ends are fully entered and inner surfaces are reasonably flush and even. An approved mechanical pipe puller shall be used for joining conduits over 36" diameter.

Joints shall conform to Article 2 and shall be sealed with gasket material conforming to Article 2 installed in accordance with the manufacturer's recommendation.

Types 2 and 3 joints shall be wrapped with plastic filter cloth for a minimum of 12" on each side of joint. Ends of the cloth shall be lapped at least 10" and edges and ends of cloth shall be suitably secured.

### **C. METAL CONDUIT**

Metal conduit shall be firmly joined by coupling bands conforming to Article 2. Bands shall lap over any equal portion of each conduit section. Connecting band width shall conform to Article 2.

For Type 1 joints, flexible plastic gasket material shall be placed in one (1) corrugation recess on each side of the joint at the coupling band and on each band connection in such manner to prevent leakage. Gasket material shall be placed in accordance with the manufacturer's recommendations.

When Type 2 or 3 joints are specified, joining of metal conduit section shall conform to the following provisions:

#### **1. General**

Band joints shall be sealed with gasket material conforming to Article 2. Plastic gasket material shall be placed in the first two (2) corrugation recesses on each side of conduit connections. Plastic gasket material shall also be placed on each band connection in such manner to prevent leakage. Gasket material shall be placed in accordance with plan details or as directed by the Engineer. The joint shall be wrapped with plastic filter cloth for a minimum of 12" on each side of the connecting band. Ends of cloth shall be lapped at least 10", and edges, and ends of cloth shall be suitably secured.

#### **2. Circular Section**

Connecting bands shall be of an approved design and shall be installed in accordance with plan details or as directed by the Engineer.

#### **3. Arch Section**

Bands shall be connected at the ends by approved angle or strap connections. Connecting bands used for 36" round equivalent diameter pipe arch and above shall be two (2) piece bands.

**ARTICLE 7 - BACKFILLING**

As soon as the joints are completed and checked, backfill material, free from large clumps, rocks or other hard substances shall be deposited evenly on both sides of the pipe in layers not exceeding 8" thick. Each layer shall be compacted by use of approved mechanical tampers to 95% of maximum density. Maximum density and in-place density shall be determined in accordance with DOTD Designations TR418 and TR401, respectively. Backfilling shall proceed in this manner to a point 12" above the top of the pipe. Care should be exercised in backfilling around the pipe to avoid displacement of or damage to the pipe. All backfill material shall be approved before placement.

The remainder of the backfill over and above 12" above the surface of the pipe shall be thoroughly compacted to a minimum of 95% of maximum density at optimum moisture. Caution shall be exercised to avoid any damage to the pipe during compaction. Backfill material shall contain no stumps or roots and shall be free of lumber, trash, or other debris. The method of compaction shall be approved by the Engineer. *Compaction shall be verified through compaction tests ordered by the Engineer.* In the event the material excavated during the trenching operation has a high moisture content, this material shall be dried to optimum moisture by blading and disking or other suitable methods prior to backfilling. If unsuitable material for backfilling is encountered in a given location, suitable trench or roadway excavation from other locations on the project shall be used in the backfill operation. In lieu of the previously described method of obtaining suitable backfill material, the Contractor may, at his option and at no additional cost to the Owner, backfill with granular material conforming to Article 2 - Materials, of this section. All granular material shall be compacted to the same density described previously in this paragraph. If part of the trench lies in an area designated to be surfaced and paralleling the centerline of the roadway, the total width of the trench shall be compacted as designated in this paragraph.

All fences, markers, mail boxes, street signs or other temporary obstacles shall be removed by the Contractor and immediately replaced after the trench is backfilled in their original position or as indicated by the plans at no direct payment. The Contractor shall notify the Engineer and property owner at least 24 hours in advance of any work done on easements or rights-of-way.

It is expressly understood that the Contractor shall restore all easements and rights-of-way to a condition equal to its original condition, and in a condition satisfactory to the property owners and the Engineer.

Trenching, backfilling, and hauling excess material as specified herein shall be considered as incidental to the work and will not be measured or paid for under these items.

**ARTICLE 8 - STUBBING PIPE INTO CONDUITS**

The Contractor shall stub conduits into new or existing conduits at locations shown on the plans with an approved mortar joint. Furnishing and installing new conduits will be paid as specified in Article 15, of this section of the specifications. Stubbing of conduits will be considered incidental to the work and will not be measured for direct payment.

**ARTICLE 9 - FLUSHING DRAINAGE LINES**

If storm drainage lines are found to contain sand, gravel or other foreign matter when inspected by the Engineer, they shall be flushed with a sufficient volume of water to remove all foreign matter prior to final acceptance. The Contractor shall furnish all water at no cost to the Owner.

**ARTICLE 10 - MAINTENANCE OF TRAFFIC**

The Contractor shall conduct his operations in such a manner so that interference with public travel will be minimized. The Contractor shall provide and maintain, at his own expense, suitable bridges, detours or other temporary facilities for the accommodation of public or private travel, as directed by the Engineer. Twenty-four (24) hour notice to owners of private driveways shall be given prior to interfering with them. Maintenance of traffic may be curtailed providing that the Contractor shall obtain permission from the owners or tenants of private property or proper authority, or both, to obstruct traffic within the said limits and time agreed upon. The Contractor shall keep the police and local fire protection authorities informed at all times of the location of construction operations and fire lanes and shall maintain access for fire fighting equipment as requested by the Fire Department. One-way traffic shall be maintained on all streets during construction, except where suitable detours or other arrangements are agreed to. Upon completion of backfilling, the Contractor shall have a motorized rubber wheel road grader on the job site. This grader shall be used to maintain the roadway in a satisfactory condition approved by the Engineer for the duration of the Contract. All barricades, warning signs, lights, temporary signals and other protective devices are to be utilized in the maintenance of traffic shall conform with the Louisiana Manual on Uniform Traffic Control Devices.

**ARTICLE 11 - CARE OF STREET, SIDEWALKS, AND ROADS**

The Contractor shall be required, at his own expense, to remove all excess materials, debris or other obstruction from the streets or roads immediately after the backfilling has been completed. No cross streets, sidewalks, or roads shall be wholly obstructed except by special permission from the Engineer. If at any time the Contractor neglects to remove such materials or obstruction and place streets, sidewalks, and roads in suitable condition for traffic within 24 hours after having received written notice from the Engineer, the work may be done by the Owner, and the cost thereof charged to the Contractor and deducted from his final estimate. The Contractor shall repair or replace streets, sidewalks, roads, and culverts to the satisfaction of the Engineer and parties concerned.

**ARTICLE 12 - BARRICADES**

The Contractor shall provide barricades at locations where there exists an open hole or trench or trenches that have not had sufficient settlement to withstand traffic loads. All such barricades shall be properly lighted at night, and shall conform with the Louisiana Manual on Uniform Traffic Control Devices.

**ARTICLE 13 - PROTECTION OF PUBLIC OR PRIVATE PROPERTY AND EASEMENTS**

The Contractor shall continuously maintain and protect all underground and above ground utilities, including the restoration of all public utilities, including water mains, water services, gas mains, gas services, culverts, drains, ditches, curbs, sidewalks, landscaping and/or other facilities which may be damaged, to a condition at least equal to their original status, at no additional cost to the Owner, unless covered elsewhere in these specifications. All water mains and services shall be repaired within 6 hours.

All construction work under this contract on easements, right-of-way through private property or franchise shall be confined to the limits of such easements, right-of way or franchise. All work shall be accomplished so as to cause the least amount of disturbance and a minimum amount of damage. The Contractor shall schedule his work so that trenches across easements shall not be left open during weekends or holidays, and trenches shall not be left open for more than 48 hours.

Prior to excavation on an easement or private right-of-way, and where required by the Engineer, the Contractor shall strip top soil from the trench or construction area and stockpile it in such a manner that it may be replaced by him, upon completion of construction. Ornamental trees and shrubbery shall be carefully removed, with the earth surrounding their roots wrapped in burlap and replanted in their original positions within 48 hours. All shrubbery or trees destroyed or damaged, shall be replaced by the Contractor with material of equal quality at no additional cost to the Owner. In the event that it is necessary to trench through any lawn areas, the sod shall be carefully cut and rolled and replaced after the trenches have been backfilled, the backfilling and compacting to be as described for surfaced areas. The lawn area shall then be cleaned, by sweeping or other means, of all earth and debris.

**ARTICLE 14 - EXCESS MATERIAL**

Material excavated during the trenching operation that is not used for backfilling the pipe shall be promptly hauled off the project by the Contractor. There shall be no direct payment for the work described in this article. Compensation for said work shall be included in the contract unit price for "Furnishing and Installing Conduit".

**ARTICLE 15 - PAYMENT****A. CONDUIT**

Conduit will be measured by the linear foot complete in place. Conduit not confined by a fixed structure or structures will be measured by the number of joints at the nominal length of each joint. Conduit confined by fixed structures will be measured along the conduit between termini of the pipe in the structure walls. Conduit confined by a fixed structure on one end and unconfined at the other end will be measured along the conduit from the terminus of the pipe in the structure wall to the unconfined end of the conduit.

The accepted quantities of culverts and storm drainage pipe measured as provided herein will be paid for at the contract price bid per unit of measurement for each of the pay items listed below:

PAY ITEM	UNIT
Concrete Pipe (Size)	Linear Foot
Reinforced Concrete Pipe (Size)	Linear Foot
Reinforced Concrete Pipe Arch (Size)	Linear Foot
Corrugated Steel Pipe (Size)	Linear Foot
Corrugated Steel Pipe Arch (Size)	Linear Foot
Bituminous Coated Corrugated Steel Pipe (Size)	Linear Foot
Bituminous Coated Corrugated Steel Pipe Arch (Size)	Linear Foot
Corrugated Aluminum Pipe (Size)	Linear Foot
Corrugated Aluminum Pipe Arch (Size)	Linear Foot
Asbestos Bonded Corrugated Steel Pipe (Size)	Linear Foot
Asbestos Bonded Corrugated Steel Pipe (Smooth Lined) (Size)	Linear Foot
Asbestos Bonded Corrugated Steel Pipe Arch (Size)	Linear Foot
Asbestos Bonded Corrugated Steel Pipe Arch (Smooth Lined) (Size)	Linear Foot
Structural Plate Pipe (Size)	Linear Foot
Structural Plate Pipe Arch (Size)	Linear Foot
Corrugated Metal Pipe (Size)	Linear Foot
Corrugated Metal Pipe Arch (Size)	Linear Foot
Culvert Pipe (Size)	Linear Foot
Culvert Pipe Arch (Size)	Linear Foot
Pipe Conduit (Size) RCP or (Size) CMP	Linear Foot
Pipe Arch Conduit (Size) RCPA or (Size) CMPA	Linear Foot
Polymeric Coated Corrugated Steel Pipe (Size)	Linear Foot
Polymeric Coated Corrugated Steel Pipe Arch (Size)	Linear Foot

Payment for culverts and storm drainage pipe shall constitute full compensation for all materials, labor, equipment, tools, and supplies necessary to complete each respective item. No separate payment shall be made for any trenching, select bedding material, backfill, maintenance of traffic, barricades, flushing of sewer lines, and all costs in connection therewith shall be considered incidental to the work and included in the contract unit price for furnishing and installing the culverts and storm drainage pipe.

**TECHNICAL SPECIFICATIONS  
FOR  
STORM DRAINAGE MANHOLES, INLETS,  
JUNCTION BOXES, AND CATCH BASINS**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section of the specifications consists of the construction and adjustment of storm drainage manholes, inlets, junction boxes and catch basins in accordance with these specifications, and in reasonably close conformity with the lines and grades shown on the plans or established by the Engineer.

**ARTICLE 2 - MATERIALS**

**A. GENERAL**

The Contractor shall have the option of furnishing structures of either cast-in-place concrete or precast units; however, design, fabrication, testing and installation procedures for precast concrete units will be subject to approval by the Engineer. The Contractor will be responsible for furnishing all testing and quality control required by the Engineer for the precast units.

**B. CONCRETE**

The concrete shall have a minimum compressive strength at twenty-eight (28) days as shown on the plans when tested in accordance with DOTD Designation TR 230. Concrete shall have a minimum compressive strength of 3,500 psi when not specified on the plans.

Portland cement shall comply with the standard specifications for Portland cement and shall be Type 1.

**C. BRICK**

Brick shall be made from concrete meeting the requirements of ASTM Designation: C 139, except that the minimum thickness of each unit shall not be less than 3 5/8 inches.

**D. MANHOLE STEPS, FRAMES, GRATES AND COVERS**

All castings shall be true to pattern in form and dimensions and free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. The castings shall be boldly filleted at angles and the arises shall be sharp and perfect. Malleable casting surfaces shall have a workmanship finish.

All castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

1. Gray Iron Castings: Gray iron castings shall conform to ASTM Designation: A 48, Class 30.
2. Malleable Castings: Malleable castings shall conform to ASTM Designation: A 47, Grade 35018.
3. Galvanizing, where specified, shall conform to AASHTO Designation: M 111.
4. Manhole steps shall be from a source approved by the Engineer.

**E. ASPHALTIC VARNISH**

Asphaltic varnish shall be composed of hard native asphalts or asphaltites (gilsonite, for example), run (fluxed) and blended with properly treated drying oils and thinned for suitable solvents together with the necessary amount of drier. Asphaltic varnish shall conform to Section 1008.07 of the Louisiana Department of Transportation and Development's "Standard Specifications for Roads and Bridges".

**F. REINFORCING STEEL**

Reinforcing steel shall be deformed billet steel bars, Grade 40, conforming to ASTM Designation: A 615. Reinforcement shall be furnished in full lengths for each pour. Splicing of bars will not be permitted unless approved by the Engineer. Any splices shall be lapped as directed by the Engineer.

**ARTICLE 3 - CONSTRUCTION REQUIREMENTS**

Concrete shall be placed so as to avoid segregation of the materials and displacement of the reinforcement. During and immediately after depositing, all concrete shall be consolidated by using internal mechanical vibrators. Concrete shall be placed in horizontal layers, the thickness of which is to be determined by the Engineer. The concrete, between pours, shall be cleaned of loosened particles and other objectionable material to a sufficient depth to expose sound concrete. All accumulations of mortar splashed upon the reinforcement steel and surfaces of forms shall be removed before the next pour is made.

Construction joints shall be made only where located on the plans or approved by the Engineer. Raised shear keys or reinforcing steel shall be used where necessary to transmit shear or bond the two sections together.

Forms shall be wood or metal and shall be designed and built so as to be mortar tight, sufficiently rigid to prevent pressure distortion and capable of being removed without injuring the concrete. Forms shall not be removed until the concrete has obtained sufficient strength to support the load imposed or as directed by the Engineer.

All exposed concrete surfaces shall be finished with a wood float to give a smooth, level surface. At the proper time, the surface shall be brushed to give a broom-finish. All joints and intersecting edges shall be finished with an edging tool having a 1/4 inch radius. When required by the plans, exposed surfaces of completed concrete shall be finished by rubbing the exposed surface with carborundum or other abrasive to a smooth surface and all form marks shall be removed. Nonexposed surfaces shall have the form finish, except that all defects and holes shall be corrected.

Brick masonry joints shall be full mortar joints and shall not be more than 1/2 inch wide. Mortar shall consist of one (1) part Portland cement, two (2) parts approved sand, and water as required for proper consistency. Mortar shall be used within thirty (30) minutes after mixing.

Reinforcing steel shall be cold bent to the shapes on the plans. All steel reinforcement shall be placed as near as practicable in the position shown on the plans and firmly held during the placing of the concrete. When placed in the structure, it shall be free from dirt, base rust, loose scale, paint, oil, grease or other foreign material.

Metal frames shall be set in full mortar bed. Conduit sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the conduit.

When grade adjustment of existing structures is specified, the frames, covers and gratings shall be removed and the walls constructed as required. The cleaned frames shall be reset at the required elevation. All metal parts shall be thoroughly cleaned and placed in good repair. When permitted by the Engineer, in lieu of adjusting structures by the foregoing method, the Contractor may adjust the structures to the required grade by means of approved metal adjustment rings.

Upon completion, each new or adjusted structure shall be cleaned of any accumulations of silt, debris or other foreign matter, and all metal parts shall be coated with asphaltic varnish. The structures shall be kept clear of such accumulations until acceptance of the work.

After inspection of completed structures and when directed by the Engineer, excavated areas not occupied by the structures shall be backfilled to the required elevations.

Trash, debris and timber shall be removed from the excavation prior to depositing any backfill material.

Backfill shall be from approved material obtained from excavation and/or additional borrow excavation.

All required backfill material obtained from borrow excavation shall be approved by the Engineer before placement and shall be free from large lumps, rock or other objectionable matter. It shall be the responsibility of the Contractor to locate suitable borrow material and secure all rights and privileges necessary to excavate, load, haul and deposit the material at the locations designated on the project plans.

Backfill shall be placed in layers not to exceed 8 inches in depth and shall be compacted by mechanical tampers to 95% of maximum density at optimum moisture. Backfill material shall be brought up evenly on all sides of the structure for the full required length of fill.

Any structure which is damaged during backfilling, subsequent construction or by any other cause, shall be repaired at the expense of the Contractor.

Excavated material not satisfactory for backfill, as determined by the Engineer, and any surplus material shall be disposed of by the Contractor to the satisfaction of the Engineer.

#### **ARTICLE 4 - CONNECT TO EXISTING DRAINAGE STRUCTURE**

Where required on the construction plans, the Contractor shall connect required storm drainage pipe to an existing drainage structure.

The work shall consist of removing a portion of one (1) wall of the drainage structure large enough to accommodate the required pipe and stubbing the pipe into the wall at the elevation shown on the plans. The opening remaining around the pipe shall be sealed with grout to make the connection watertight.

The Contractor shall be responsible for any damage to the existing drainage structure and shall repair any and all damage at no cost to the Owner.

#### **ARTICLE 5 - PAYMENT**

##### **A. GENERAL**

Measurement for storm drainage structures will be by the unit. Payment for storm drainage structures shall constitute full compensation for all materials (including castings), equipment, tools, labor and supervision necessary to complete each respective item.

No separate payment shall be made for any excavation for storm drainage structures and all excavation required in connection therewith shall be considered incidental to the work and will not be measured for separate payment.

Backfill for storm drainage structures with approved material obtained from site excavation will be considered incidental to the work and will not be measured for separate payment.

##### **B. JUNCTION BOXES**

Junction boxes will be measured by the unit, complete and in place. The accepted quantities will be paid for at the contract unit price per each for "Junction Boxes (Type Specified)" as described in Article 5A above.

##### **C. MANHOLES**

Manholes will be measured by the unit, complete and in place. The accepted quantities will be paid for at the contract unit price per each for "Manholes (Type Specified)" as described in Article 5A above.

##### **D. DROP INLETS**

Drop inlets will be measured by the unit, complete and in place. The accepted quantities will be paid for at the contract unit price per each for "Drop Inlets (Type Specified)" as described in Article 5A above.

##### **E. CATCH BASINS**

Catch Basins will be measured by the unit, complete and in place. The accepted quantities will be paid for at the contract unit price per each for "Catch Basins (Type Specified)" as described in Article 5A above.

**F. ADJUSTING STORM DRAINAGE STRUCTURES**

Adjustment of storm drainage structures will be measured by the unit, complete and adjusted to the required grade. The accepted quantities will be paid for at the contract unit price per each for "Adjusting (Type Structures)".

**G. BORROW EXCAVATION**

When the contract does not contain a pay item for borrow excavation, the furnishing and placing of additional backfill material from borrow excavation will be considered incidental to the work and will not be measured for separate payment.

When the contract contains a pay item for borrow excavation, the accepted quantities of additional backfill material obtained from borrow excavation shall be measured by the cubic yard (vehicular measurement) and paid for at the contract unit price per cubic yard for "Borrow Excavation".

**H. CONNECT TO EXISTING DRAINAGE STRUCTURE**

Payment for completing the necessary work for making the connections to the existing drainage structures at the locations shown on the drawings or directed by the Engineer shall be paid for at the contract price bid per each for "Connect to Existing Drainage Structure". Such price shall constitute full compensation for all labor, materials, supplies, equipment and tools necessary to complete all the work in accordance with these specifications.

**ARTICLE 6 - TYPICAL PAY ITEMS**

PAY ITEM	UNIT
Junction Boxes (Type)	Each
Manholes (Type)	Each
Drop Inlets (Type)	Each
Catch Basins (Type)	Each
Adjusting (Type Structure)	Each
Borrow Excavation	Cubic Yard (Vehicular Measurement)
Connect to Existing Drainage Structure	Each

**TECHNICAL SPECIFICATIONS  
FOR  
EXCAVATION, EMBANKMENT, GRADING AND  
SHAPING FOR ROADWAY AND DITCHES**

**ARTICLE 1 - SCOPE OF WORK**

This work consists of excavation, disposal, placement and compaction of all materials that are not provided for under other sections of these specifications, including excavation and embankment construction for roadways and other structures, excavation for ditches and channels, and all other grading operations necessary for the work in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

**ARTICLE 2 - UNCLASSIFIED EXCAVATION**

Unclassified excavation shall consist of all excavation within the street right-of-way not otherwise classified and paid for including existing asphaltic concrete surfacing and base course.

**ARTICLE 3 - BORROW**

Borrow is defined as usable soils required for construction of embankments or other portions of work in excess of usable material available from required excavation and obtained from an approved source. The Contractor shall make his own arrangements for obtaining borrow material. Borrow may be required even though not shown on the plans.

**ARTICLE 4 - USABLE SOILS**

Usable soil is defined as soil material whose composition is designated satisfactory for use in embankment construction. Moisture content has no bearing upon such determination.

Soil materials, whether from required excavations or borrow excavation, shall have been tested and classified in their original position by the laboratory before being placed in embankments or other final position on the project; shall be subject to the restrictions for soil materials hereinafter contained; and shall be soils conforming to DOTD Designation: TR 423, Classes A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-3, A-4, A-5, A-6, A-7-5, and/or A-7-6, except that soils in Classes A-5, A-6, A-7-5 and A-7-6 considered unusable by the Engineer, and soils with a plasticity index exceeding 60, will not be accepted.

When "Select Fill" is specified, the soil materials furnished shall be soils conforming to DOTD Designation: TR 423 Classes A-1-a, A-1-b, A-3, A-2-4, A-2-6, A-4, or A-6 having a maximum Liquid Limit of 35 and a maximum plasticity index of 15.

The Contractor shall notify the Engineer in writing at least 15 days in advance of borrow operations so that samples may be taken and soil tests completed prior to beginning the excavation. The Contractor's notification shall include a location sketch of the borrow area. The Contractor will not be permitted to begin borrow operations until soil tests have been completed and materials approved for use.

**ARTICLE 5 - GENERAL REQUIRMENTS**

Excavation and embankment shall be finished to reasonably smooth and uniform surfaces. Excavation operations shall be so conducted that material outside construction limits will not be disturbed.

Prior to beginning excavation, grading and embankment operations in an area, all necessary clearing and grubbing in that area shall have been completed.

When obliteration of old roadways is required, it shall include all grading operations necessary to satisfactorily incorporate the old roadway into the new roadway and surroundings. Roadway obliteration will be paid for as unclassified excavation.

In preparation of the natural ground to receive embankment material or preparation of the finished section in a cut area on which fill or base materials is to be placed, the Contractor shall attempt all normal earthwork construction methods before

undercutting or modifying the soil with additives will be considered by the Engineer. Such construction methods shall include, but are not limited to, the following:

- (a) Drainage and drying of the surface until the material is within reasonable limits of optimum moisture before compaction is attempted.
- (b) Using lighter construction equipment for manipulation, disking, drying and compaction of the material.
- (c) Dumping successive loads of material in a uniformly distributed layer of a thickness necessary to support the equipment while placing subsequent layers.
- (d) Rerouting heavy construction equipment around the area until the embankment can support such equipment without damage to foundation soils.

Unstable materials shall be removed by undercutting, unless otherwise directed, and the areas backfilled to the required section with usable soils as directed.

If undercutting is required, the Contractor shall conduct his operations in such manner that the engineer can make the necessary measurements before the backfill is placed. Undercut will be paid for as unclassified excavation, and the required usable soils for backfilling will be paid for as embankment. Measurement of undercut will be made to the subgrade or original ground line, whichever is lower.

Embankment construction consists of constructing roadway embankments, including preparation of the areas upon which they are to be placed; constructing dikes, when required; placing and compacting of approved material in areas where unusable material has been removed; placing and compacting embankment material in holes, pits, and other depressions; and placing and compacting embankment materials for backfilling structures. Embankment materials shall not be placed or spread on portland cement concrete or asphaltic concrete pavements (including friction, wearing, binder, or base courses) and embankment operations shall be conducted in such a manner that pavement surfaces, edges and joints are not damaged.

The Contractor shall be responsible for the stability of all embankments constructed under the contract until final acceptance of the work and shall bear the expense of replacing any portions which have become displaced due to negligent work by the Contractor, or to damages resulting from natural causes, such as rainfall, etc., and not attributable, in the opinion of the Engineer, to unavoidable movements of the ground on which the embankment is constructed.

Rocks, broken concrete or other solid materials shall not be placed in embankment areas where piling is to be placed.

If embankments are to be constructed on a surface sloping more than 6:1 from the horizontal, the slope of the ground on which the embankment is to be placed shall be cut into steps as directed before the fill is placed. If a new roadway is to be constructed on an existing roadbed, and the surface of the existing roadbed is within 1 foot of the finished subgrade, the existing roadbed shall be scarified full width to a depth of not less than 12 inches and recompacted as directed.

Where an embankment is to be constructed to a height of less than 3 feet, heavy sod and objectionable vegetable matter shall be removed from the embankment area and the area shall be scarified to a depth of approximately 12 inches. This area shall be recompacted as directed. When height of fill is 3 feet or more, heavy sod and objectionable vegetable matter shall be removed from the embankment area and the area shall be scarified to a depth of approximately 12 inches. This area shall be recompacted as directed.

If embankment material is to be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause excessive pressure against the structure. The fill adjacent to the end bent of a bridge shall not be placed higher than the top of the substructure until the superstructure is in place. When the embankment is to be deposited on both sides of a concrete wall or similar structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

Excess and unusable excavated material, when permitted, may be placed on the side slopes of the nearest fill or berm in a satisfactory manner. If it is impossible to dispose of all such material in the manner described, the remainder shall be satisfactorily disposed of beyond the limits of the right-of-way.

Embankment material shall be placed in layers approximately parallel to the finished grade line not exceeding 8 inches thick (COMPACTED). Each layer shall be placed for the full width of embankment, brought to a uniform moisture content and compacted to at least 95 percent of maximum density (STANDARD PROCTOR) before the next layer is placed. Operations shall be conducted in such manner as to obtain bonding between layers. Water shall be added or removed as necessary to obtain required density. At the Contractor's option, approximately the top 2 inches of intermediate layers may be compacted with the succeeding layer. The 2 inch layer of the previous lift shall be brought to optimum moisture before placing the subsequent lift. Compaction of embankments may be accomplished by any method that will obtain the specified density. Dumping and rolling areas shall be kept separate.

When embankments are constructed in lakes, streams, swamps or other unstable areas and the unstable material cannot be economically removed or the area drained, the requirement for placing material in layers as outlined above may be waived and the embankment placed by end dump or other approved methods to an elevation where it is determined by the Engineer that normal construction methods can begin. Embankments placed above this elevation shall be constructed in layers as specified above.

Maximum density will be determined in accordance with DOTD Designation: TR 418 and in-place density in accordance with DOTD Designation TR 401. The frequency for density testing will be a minimum of 1 test per lift per 1,000 linear feet of roadway and 1 test per lift per 3,000 square feet of parking lot and site grading areas.

#### **ARTICLE 6 - METHOD OF MEASUREMENT**

##### **A. General**

Unless designated otherwise on the construction plans, all excavated material shall become the property of the Contractor. Usable material from excavation items may be used in embankments or other finished sections of the project. Excavated material that is surplus or unusable shall be disposed of by the Contractor beyond the right-of-way limits.

No measurement will be made of material temporarily removed and replaced to facilitate compaction of the material.

##### **B. Unclassified Excavation and Embankment (Cubic Yard Measurement)**

Contract quantities for Unclassified Excavation and Embankment are estimated with sufficient accuracy for payment without the need for final measurement and verification of the width, elevation and horizontal position of the in-place roadway. Contract quantities for these items will be used for payment except where adjustments are made through formal contract change orders. Excavation and embankment for crossovers, turnouts, driveway approaches and other minor installations will not be included in the estimate.

##### **C. Excavation and Embankment (Linear Measurement)**

When excavation and embankment is to be measured on a linear basis, the length will be measured along the centerline of the roadway to the nearest foot, which includes performing all excavation, embankment and grading work necessary for construction of the project. It is the Contractor's responsibility to determine the quantities of earthwork necessary to complete this item. Measurement at intersections shall be made through the intersection along the centerline of the through street. Measurement for intersecting streets shall be made along the centerline of the intersecting street to the pavement edge of the through street.

##### **D. Borrow (Vehicular Measurement)**

The material will be measured by the cubic yard in approved hauling vehicles at the point of delivery. Vehicles may be of any size or type acceptable to the Engineer, provided the vehicle body is of such shape that the volume can be readily and accurately determined.

No measurement will be made for excavation for culverts or culvert headwalls.

**ARTICLE 7 - PAYMENT**

The accepted quantities will be paid for at the contract unit prices, which include furnishing all equipment, labor and materials necessary to complete the items.

No direct payment will be made for acquisition of borrow materials outside the right-of-way, acquisition of right-of-way and constructing haul roads, stockpiling and rehandling of materials, precautionary measures to protect private property and utilities, and furnishing necessary water and watering equipment.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Unclassified Excavation	Cubic Yard
Embankment	Cubic Yard
Excavation and Embankment	Linear Foot
Borrow (Vehicular Measurement)	Cubic Yard

**TECHNICAL SPECIFICATIONS  
FOR  
FERTILIZER AND SEEDING**

**ARTICLE 1 - SCOPE OF WORK**

The work covered by this section shall consist of preparing seed beds and furnishing and applying fertilizer and grass seed on the areas designated on the plans or as directed.

**ARTICLE 2 - MATERIALS**

**A. SEED**

Seed shall conform to all requirements, rules and regulations of Louisiana Revised Statutes 3:1431, et seq. The minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with Table 1 herein.

Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which is a Number 6 standard shipping tag, minimum, containing all information required by the Louisiana Seed Law.

All seed furnished shall be the previous season's crop (the last crop year for the crop kind in question) and the date of analysis shown on each tag shall be within five (5) months (excluding the month in which the test is completed) of the time of delivery of the project.

<b>TABLE 1 SEED REQUIREMENTS</b>		
<b>KIND</b>	<b>MINIMUM % OF PURE LIVE SEED (PURITY TIMES GERMINATION INCLUDING HARD SEED)</b>	<b>MAXIMUM % OF WEED SEED</b>
Hulled Bermuda	83	1
Carpet Grass	76	2
Pensacola Bahia	81	2
Dixie Crimson Clover	78	1
Kentucky 31 Fescue	80	1
Centipede	82	1
Rye	80	2

(1) **Noxious Weeds:** Noxious weeds shall be interpreted to mean that list of weeds, except Bermuda, which has been adopted by the Louisiana Seed Commission as being noxious in Louisiana. Noxious weed seeds shall not exceed the limitations prescribed in the regulations and in no case shall they exceed 500 seeds per pound.

Analysis tags shall be removed from each bag or container only by the Engineer or his authorized representative.

Seed shall be selected on the basis of five (5) general soil areas shown as follows:

- (1) Alluvial soils of Mississippi and Red River bottoms
- (2) Mississippi terraces and loessial hill soils
- (3) Coastal plain soils (rolling, hilly and flatwoods areas in central, northern and eastern part of the state)
- (4) Coastal prairie soils
- (5) Ouachita River botto

**B. FERTILIZER**

Fertilizer shall be a commercial type conforming to the commercial fertilizer laws in effect as regulated by the Louisiana Department of Agriculture. The chemical composition shall be as specified and shall be designated by a 3-number sequence representing minimum percentages by weight, respectively, of nitrogen (N), available phosphoric acid and soluble potash. Fertilizer shall be supplied in granulated or pelletized form and shall be packaged in suitable containers to prevent contamination by moisture.

**ARTICLE 3 - PREPARATION OF SEED BEDS**

Seed beds shall be prepared by disking, harrowing or other approved methods. Soil shall be thoroughly pulverized to a minimum depth of 3 inches and leveled as directed. Hardpan areas shall be rototilled, if necessary, to ensure that soil is in condition to receive and sprout seed. If the contract requires topsoil or fertilizer, they shall be incorporated at this time. Slopes shall be smoothed to grade and rolled prior to seeding.

Seed shall be planted within the dates shown in Table 2, unless otherwise permitted in writing.

The Contractor will be allowed to apply seed by use of a hydroseeder. Under this method, the seed and fertilizer shall be distributed over the area in one (1) operation. The same rates for seed and fertilizer will apply as in the conventional method.

After seed has been planted, area shall be watered immediately with approved watering tanks. Other waterings shall follow as directed.

Any reseeding required because of growth failure shall be done by the Contractor at no additional cost to the Owner. Damage due to erosion shall be repaired by filling and tamping with topsoil and reseeding at no additional cost to the Owner. Where obvious erosion problems exist, the Contractor shall take such measures as necessary to ensure a good stand of grass. Such measures could include, but are not limited to, the following vegetative mulch, hydroseed, protective fabric or hay. All such protective measures shall be the responsibility of the Contractor and no additional payment shall be made for these items.

**ARTICLE 4 - SEEDING RATES**

**A. RURAL AREAS**

<b>TABLE 2</b>				
<b>MIXTURE</b>	<b>SEED MIXTURE</b>	<b>POUNDS PER ACRE</b>	<b>SOIL AREA</b>	<b>PLANTING DATES</b>
A	Hulled Bermuda	15	1,2,3,5	March thru September
	Pensacola Bahia	15		
B	Hulled Bermuda	10	2,3,4,5	March thru September
	Carpet	20		
C	Hulled Bermuda	10	1,2,3,5	February thru March
	Crimson Clover (1)	20		
D	Kentucky 31 Fescue	30	1,2,3,5	September thru February
	Pensacola Bahia	10		
E	Kentucky 31 Fescue	30	1,2,3,4,5	September thru February
	Crimson Clover (1)	10		
F	Kentucky 31 Fescue	20	1,2,3,5	September thru February
	Crimson Clover (1)	10		
	Pensacola Bahia	10		
G	Hulled Bermuda	30	1,2,3,4,5	March thru September
H	Kentucky 31 Fescue	40	1,2,3,4,5	September thru March
I	Crimson Clover (1)	40	1,2,3,4,5	September thru February
J(2)	Hulled Bermuda	15	1,2,3,5	February thru September
	Centipede	10		

NOTE: (1) Inoculated Prior to Planting with Proper Bacterial Culture.  
 NOTE: (2) For Urban Areas and Multiple-Use Projects.

**B. URBAN AREAS**

The rate of application of seeding shall be as follows:

<b>SEED</b>	<b>RATE PER 1,000 SQUARE FEET</b>
Centipede	0.5 Pounds
Rye	10.0 Pounds
Bermuda	2.0 Pounds

**ARTICLE 5 - FERTILIZER**

Fertilizer shall be uniformly broadcast over areas to be fertilized by either hand or machine methods. Fertilizer shall be either 8-8-8, 12-12-12, 13-13-13 or 16-16-16. The approximate rate of fertilizer application shall be as follows:

<b>TYPE</b>	<b>POUNDS PER ACRE</b>
8-8-8	1,000
12-12-12	667
13-13-13	615
16-16-16	500

The rate per acre shall be increased or decreased as directed.

Fertilizer applied after surface dressing shall be thoroughly incorporated in the soil by light disking or harrowing. Fertilizer may be applied before final disking or harrowing during surface dressing or, if dressed by hand, it may be applied before final raking and leveling.

Fertilizer will be measured by the pound. The estimated quantity shown in the plans is based on Type 8-8-8 fertilizer. If other types of fertilizer are used, the measured quantities will be multiplied by the following factors to determine pay quantities:

TYPE	FACTOR
12-12-12	1.500
13-13-13	1.625
16-16-16	2.000

## **ARTICLE 6 - PAYMENT**

### **A. SEEDING**

#### **1. Lump Sum Basis**

When payment for seeding is specified to be made by the lump sum, no measurement of seed quantities will be made. Seeding mixture and rate of application shall be as designated on the plans. Payment will be at the lump sum price bid for "Fertilizer and Seeding" which shall constitute full compensation for furnishing all required materials, equipment, labor, tools and incidentals necessary to complete this item of work.

#### **2. Quantity Basis**

If payment for seeding is specified to be made on a quantity basis, measurement and payment for seeding shall be by the number of pounds of grass seed applied and accepted at the contract unit price per pound for "Seeding (Type Specified)". Payment for seeding shall constitute full compensation for furnishing the required labor, materials, equipment, tools and incidentals necessary to complete the work described in this section.

### **B. FERTILIZER**

#### **1. Lump Sum Basis**

When payment for fertilizer and seeding is specified to be made by the lump sum, no measurement of fertilizer quantities will be made. The rate of application of fertilizer shall be in accordance with Article 5, Fertilizer. Payment will be at the lump sum price bid for "Fertilizer and Seeding" which shall constitute full compensation for furnishing all required materials, equipment, labor, tools and incidentals necessary to complete this item of work.

#### **2. Quantity Basis**

If payment for fertilizer is specified to be made on a quantity basis, measurement and payment for fertilizer shall be by the number of pounds of fertilizer applied and accepted at the contract unit price per pound for "Fertilizer". Payment for fertilizer shall constitute full compensation for furnishing the required labor, materials, equipment, tools and incidentals necessary to complete the work described in this section.

**TECHNICAL SPECIFICATIONS  
FOR  
FERTILIZER AND SEEDING**

**37.2 HYDROSEEDING/HYDROMULCHING**

**ARTICLE 1 - SCOPE OF WORK**

The work to be performed under this part shall consist of hydroseeding/hydromulching the areas indicated on the plans or directed by the Engineer. The work shall include the fine grading and dressing of the areas prior to applying the grass seed.

**ARTICLE 2 - MATERIALS**

**A. FERTILIZER AND SEED**

Fertilizer and seed shall conform to Section III-37, Technical Specifications for Fertilizer and Seeding, of these specifications.

**B. MULCH**

Mulch shall consist of wood fibers and shall be "Hydro 2000", as manufactured by CONWED, Inc.

**ARTICLE 3 - HYDROSEEDING/HYDROMULCHING**

After performing the final grading work, the Contractor shall hydroseed/hydromulch the areas designated. This operation must proceed in a timely manner so as to prevent erosion. This work shall be performed not more than thirty (30) days after the final grading work has been accomplished.

Hydroseeding/hydromulching is a process by which seed, fertilizer, water, mulch and tackifier are mixed together and pumped under pressure onto the soil surface. The equipment used in this process must be specifically designed for hydroseeding/ hydromulching and must be approved by the Engineer prior to use. A minimum of 1,500 pounds per acre (dry weight) of mulch material shall be applied with the seed, water, fertilizer and tackifier.

From April 1 to September 15, the seeding requirements shall be common hulled Bermuda grass at a rate of 50 pounds per acre. Along with the seeding, 13-13-13 fertilizer shall be applied at a rate of 500 pounds per acre.

From September 15 to April 1, the seeding requirements shall be annual rye grass at a rate of 75 pounds per acre along with unhulled Bermuda at the rate of 50 pounds per acre. Along with the seeding, 13-13-13 fertilizer shall be applied at a rate of 500 pounds per acre.

The seed and mulch shall be held in place with a tackifier (Fiber Plus Tackifier, or approved equal) applied at a minimum rate of 30 pounds per acre. The tackifier shall be applied with the seed, fertilizer, mulch and water in one operation.

The Contractor shall water the area with a fine spray immediately after sowing the seed. The Contractor shall apply water on a regular basis to promote growth and to prevent grass and soil from drying out.

Any reseeded required because of growth failure shall be done by the Contractor at no additional cost to the Owner. Damage due to erosion shall be repaired by filling and tamping with topsoil and reseeding at no additional cost to the Owner. Where obvious erosion problems exist, the Contractor shall take such measures as necessary to ensure a good stand of grass. All such protective measures shall be the responsibility of the Contractor and no additional payment shall be made for these items.

The hydroseeding and hydromulching operation shall not be considered complete until a good stand of grass is established as determined by the Engineer.

Contract time will not be charged to the Contractor when all other construction is complete and he must wait for appropriate time to plant required seed.

**ARTICLE 4 - MEASUREMENT**

Measurement for hydroseeding/hydromulching shall be by the acre actually completed within the limits established on the plans.

**ARTICLE 5 - PAYMENT**

Payment for hydroseeding/hydromulching shall be based on the unit price bid per acre actually completed. Payment shall constitute full compensation for all fertilizer, seed, mulch, tackifier, water, materials, tools, labor and equipment and for performing all work necessary to complete the item.